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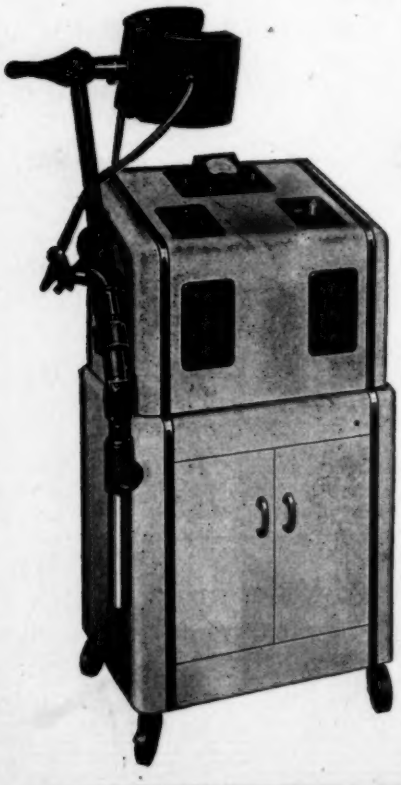

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EXPERIMENTAL STUDIES ON THE ELECTRICAL REACTIONS OF DENERVATED SKELETAL MUSCLES *

MAJOR ORA L. HUDDLESTON

Medical Corps, United States Army

For many years electrical currents have been employed in evaluation of the state of irritability of normal and abnormal tissues. The classic reaction of degeneration test[1] used in measuring the irritability of muscles and nerves is perhaps the most generally accepted clinical procedure. This method was developed and advocated by Erb[2] in 1886. Neurologists have used it extensively in electrodiagnosis, and it has been adopted generally by physical therapy physicians and neurosurgeons. In this procedure, threshold values for faradic and galvanic currents are determined, and the qualitative character of the muscular contraction and relaxation is ascertained. Minimal stimuli for cathodal closing and anodal closing contractions are determined in order to ascertain which pole of the electrical current provides the more effective stimulus. With this method of measuring the irritability of tissues it is possible to obtain only rough estimations of their relative excitability. The unit of measure of the strength of the faradic current is not expressed in electrical terms, but rather in terms of position of the secondary coil. Milliamperes are used to indicate the intensity of the galvanic direct current. More precise methods for determining the irritability of tissues have been advocated by Lapicque[3] and others.[4] Chronaxie measurements and strength-duration curves take into consideration the time required for a tissue to respond to an electrical current of a given strength; the irritability of the tissue is expressed in time units of milliseconds (1/1,000 second). Theoretically, the accuracy of these methods might be expected to be far superior to that of the cruder reaction of regeneration determination. From the electrical point of view, they are no doubt more accurate, but the biologic reactions of the tissues make the accuracy of the methods sometimes questionable. Additional refined methods of determining the electrical excitability of the neuromuscular system have been developed by other investigators.[5] Various types of electrical currents, such as sinusoidal currents, condenser discharges and so-called progressive currents, have been employed. At the present time there is considerable investigative work being carried out to determine the efficacy of some of the methods.[6] It is hoped that be-

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fore long more satisfactory quantitative methods will be developed which are suitable for clinical use in electrodiagnosis.

In the present research, determinations were made of the thresholds for faradic and galvanic stimulation and of the time-duration responses to condenser discharges (chronaxie and strength-duration curves). Complete denervation of a selected group of skeletal muscles was effected by crushing appropriate anterior nerve roots. It is believed that this surgical procedure produces a paralysis which more closely resembles that found in completely paralyzed muscles of anterior poliomyelitis than could be accomplished by any other surgical procedure. The purpose of the investigation was to measure the electrical reactions of the peripheral neuromuscular system before and after denervation. Most of the measurements after denervation were made at the end of a recovery period lasting from three to ten months. The second aim of the investigation was to determine the effects of immobilization of the denervated muscles on the state of irritability at the end of the period of recovery.

Methods

Adult dogs of various ages and sizes were employed throughout the experiments. Motor paralysis of the right hind leg was established by crushing the anterior nerve roots of the fifth, sixth and seventh lumbar and the first sacral vertebrae. The denervation of the skeletal muscle fibers was accomplished by compressing the anterior root fibers between the blades of a small hemostatic forceps. Preliminary experiments had been performed to determine the number of anterior nerve roots to be crushed in order to establish a complete paralysis of a selected group of antagonistic muscles. The muscles chosen for study were the anterior tibial and the gastrocnemius-plantaris muscles. It was found that when the anterior nerve roots mentioned were interrupted, a complete paralysis of the muscles in question was established and a minimum of paralysis of the thigh muscles and visceral structures was produced.

After the denervation of the skeletal muscles, the nerves were permitted to regenerate. In one group of animals the muscles of the right hind leg were immobilized during the period of regeneration, while in the other group no cast of any kind was applied. Various methods of immobilization were tried out before a satisfactory method was established. A modified Thomas splint constructed of 3/16-inch brass rod was used. Each splint was shaped to fit the leg of the individual dog. The proximal ring was padded with gauze and covered with adhesive tape and the splint held in position by strips of adhesive plaster which were fastened around the distal end and then applied to the skin along the lateral and medial sides of the leg from the foot to the hip. Cotton wadding was applied over the bony prominences and at various pressure points to minimize trophic changes in the skin. Gauze bandage was then applied at various places around the limb and the splint in order to hold the leg in the desired position of immobilization. The entire splint was then wrapped in gauze bandage and coated with sodium silicate (water glass) and allowed to harden. In some animals it was necessary to reinforce the cast with metal strips. These were incorporated in the layers of the gauze and water glass. When the cast was dry, a coat of shellac was applied in order to prevent the cast from becoming softened by water or urine. Clipping the canine teeth was required in some animals to prevent the cast from being chewed off too quickly. Immobilization was in a neutral position for the knee and ankle. Because of the marked atrophy

of the muscles which developed after denervation, it was necessary to reapply the cast periodically during the regeneration period.

The electrical currents used for stimulation of the tissues were supplied by a Wappler wall plate. A decade resistance box was inserted in the secondary circuit of the faradic stimulating apparatus for the purpose of securing more accurate readings of the threshold values for faradic stimulating currents. The variable resistance of the secondary circuit was calibrated by means of a cathode ray oscilloscope and found to be such that a 10,000 ohm resistance was equivalent to a change of one division of the setting of the secondary coil. It was possible to express the positions of this coil in terms of tenths and hundredths of each division of its position. No attempt was made to express the threshold in terms of voltage. They are expressed, therefore, as relative values determined by the position of the secondary coil and the amount of resistance in the secondary circuit. Thresholds for galvanic stimulating currents were measured and expressed in milliamperes. Chronaxie measurements were made by means of a Garceau chronaximeter. Strength-duration curves were plotted from data obtained with the same instrument. Determinations of the reaction of degeneration were made with the Wappler wall plate.

Results

Threshold values were determined for the nerve trunk, motor point and muscle of the neuromuscular apparatus for the gastrocnemius-plantaris and the anterior tibial muscles of the right and left hind legs. Several determinations of the thresholds were made prior to operation and the average values taken as the threshold for the normal tissues. Owing to the inaccessibility of the motor nerve supply to the gastrocnemius-plantaris muscles, no threshold values could be obtained for the motor nerve. The values for muscle were taken at a position of the muscle near the tendinous end. This point in most instances was located at a considerable distance from the motor point. It is a generally accepted fact that in order to obtain true thresholds of the irritability of muscle, it is necessary to make measurements on curarized muscles. It is likely, therefore, that the thresholds as determined in our experiments are not true values for skeletal muscle tissue. However, it is believed that when measurements are made at symmetrical points located at a considerable distance from the motor point, these values may have some significance. At any rate, it was considered worth while to make some observations by means of this procedure in order to determine whether or not any pertinent information could be obtained regarding the changes that occur in the neuromuscular system after denervation. After the denervation of the muscles of the right hind leg, repeated observations were made on the reaction of degeneration.

The data presented in this report reveal only the terminal readings of the thresholds for the different tissues. Electrical measurements were made on two series of animals. In group I (4 animals) the muscles of the right hind leg were denervated and the leg immobilized in neutral position immediately after operation. In group II (6 animals) the same muscles were denervated and no immobilization of any type was applied. In these experiments the study of the electrical reactions of the tissues were limited to the changes which take place during the period of regeneration. Different durations of regeneration were allotted before the terminal readings were made. The duration of the recovery time for the animals included in group I ranged from 109 to 276 days; that for the animals in group II ranged from 95 to 290 days. The principal objective sought in these experi-

ments of relatively long duration was to determine the status of the electrical excitability of the tissues at the end of the recovery period.

TABLE 1. — *Results of Electrical Tests of Animals in Group I.**

Thresholds for Faradic Stimulation.†
Strength of Faradic Stimulus (Position of Secondary Coil).

Dog No.	Duration	Right Leg (Denervated). Gastrocnemius-Plantaris. Motor Point	Gastrocnemius-Plantaris. Muscle	Tibialis Anticus. Nerve	Tibialis Anticus. Motor Point	Tibialis Anticus. Muscle	Left Leg (Control). Gastrocnemius-Plantaris. Motor Point	Gastrocnemius-Plantaris. Muscle	Tibialis Anticus. Nerve	Tibialis Anticus. Motor Point	Tibialis Anticus. Muscle
51	109	2.92	3.99	1.95	2.84	2.94	1.97	2.93	0.89	1.91	1.99
48	194	1.92	1.98	1.95	1.99	1.97	0.87	0.93	0.49	0.87	0.91
28	214	2.97	3.00	3.00	2.99	3.86	2.93	2.84	1.87	2.94	2.89
19	276	2.97	2.91	1.91	2.93	2.99	1.91	1.97	0.84	1.92	1.98
Total		10.78	11.88	8.81	10.75	11.76	7.68	8.67	4.09	7.64	7.77
Average percentage		2.69	2.97	2.20	2.69	2.94	1.92	2.17	1.02	1.91	1.94
Difference		40.1	36.4	117.0	40.8	51.0	.....	.....	.....	.....	.....

Thresholds for Galvanic Stimulation.‡
Strength of Galvanic Stimulus in Milliamperes.

Dog No.	Duration	Right Leg (Denervated). Gastrocnemius-Plantaris. CCC§	ACC‖	Tibialis Anticus. CCC	ACC	CCC	ACC	Left Leg (Control). Gastrocnemius-Plantaris. CCC	ACC	Tibialis Anticus. CCC	ACC	CCC	ACC	CCC	ACC	CCC	ACC	CCC	ACC	CCC	ACC
51	109	3.8	4.3	4.7	5.9	3.1	4.7	3.7	4.1	4.3	6.9	2.5	3.2	3.1	3.9	2.1	2.5	2.6	3.1	3.0	4.0
48	194	3.4	6.0	4.2	6.8	3.5	5.8	3.9	5.0	3.8	3.8	2.3	2.9	2.0	2.5	0.4	1.5	2.0	1.5	2.0	1.9
28	214	3.0	6.4	3.0	4.0	3.0	7.8	4.0	6.0	3.5	5.0	3.0	6.0	1.8	2.0	1.0	3.0	3.0	4.0	3.0	5.0
19	276	2.5	4.5	3.0	5.5	2.0	2.6	3.0	5.0	4.0	5.0	2.0	4.0	1.5	3.0	1.0	2.0	2.0	3.0	2.5	4.1
Total		12.7	21.2	14.9	22.2	14.6	20.9	14.6	20.1	15.6	20.7	9.8	16.1	8.4	11.4	4.5	9.0	9.6	11.6	10.5	15.0
Average percentage		3.2	5.3	3.7	5.5	3.6	5.2	3.6	5.0	3.9	5.2	2.4	4.0	2.1	2.8	1.1	2.2	2.4	2.9	2.6	3.7
Difference		33.3	32.5	76.2	96.4	227.0	136.0	50.0	72.4	50.0	40.5	....	....	....	....	....	....	....	....	....	....

* In group I the muscles of the right leg were denervated and the leg immediately immobilized in neutral position.
† Thresholds for faradic stimulation vary directly with the numerical position of the secondary coil.
‡ Thresholds for galvanic stimulation vary directly with the numerical value of the milliammeter readings.
§ CCC, cathodal closing contraction.
‖ ACC, anodal closing contraction.

It will be observed in table 1 that thresholds for both faradic and galvanic stimulation were higher for the muscles of the right leg (denervated muscles) than for those of the left (normal control muscles). The thresholds for normal tissues for both kinds of currents were consistently lower for the nerve tissue than for the motor point, and those for the muscles in almost every instance were higher than for the motor point. This relationship was found to be true both for the anterior tibial and for the gastrocnemius-plantaris muscles. The average percentage difference between the thresholds for tissues of the right and of the left leg, respectively, ranged from a 76 to a 117 per cent increase. The increase was consistently higher for the nerve tissue. The thresholds for galvanic stimulation of the tissues of the left (control) leg ranged from 1.0 to 4.0 milliamperes, and the values for the anodal closing contractions were consistently higher than for the cathodal closing contractions. The same relationship held true for the neuromuscular tissues of the right leg so far as polarity was concerned.

Thresholds for both cathodal closing contractions and anodal closing contractions were higher for the tissues of the previously denervated muscles.

These values indicate definitely that so far as the electrical reactions were concerned, there was a persistent elevation of threshold for all tissues (nerves, muscles and motor points) of the right hind leg. With the tissue showing decided responses to faradic stimulation and an elevation of threshold for both galvanic and faradic currents, it may be said with certainty that a partial reaction of degeneration was present at the end of the recovery period. The percentage difference between the normal and the previously denervated muscles ranged from 40 to 227; the greatest increase occurred in the nerve fiber.

TABLE 2. — *Results of Electrical Tests of Animals in Group II.*

Thresholds for Faradic Stimulation.†
Strength of Faradic Stimulus (Position of Secondary Coil).

Dog No.	Duration	Right Leg (Denervated). Gastrocnemius-Plantaris. Motor Point	Muscle	Tibialis Anticus. Nerve	Motor Point	Muscle	Left Leg (Control). Gastrocnemius-Plantaris. Motor Point	Muscle	Tibialis Anticus. Nerve	Motor Point	Muscle
69	95	0.99	2.92	.....	3.00	3.00	0.97	1.90	1.00	2.60	3.60
66	117	4.80	5.94	4.00	5.00	6.00	2.88	3.88	0.78	0.96	1.99
44	149	0.99	1.97	1.81	1.94	1.98	0.89	0.91	0.69	0.80	0.84
15	257	0.92	0.97	0.78	0.90	0.98	0.89	0.92	0.76	0.91	1.90
4	290	0.80	1.99	0.82	0.89	0.90	0.74	0.91	0.80	0.90	0.92
3	289	0.77	0.87	0.74	0.78	0.90	0.93	1.93	0.59	0.72	0.91
Total		9.27	14.66	8.15	12.51	13.76	7.30	10.45	4.62	6.89	10.16
Average percentage		1.54	2.44	1.63	2.08	2.29	1.21	1.74	0.77	1.15	1.69
Difference		27.2	40.2	112.0	80.8	35.5	.....	.....	.....	.....	.....

Thresholds for Galvanic Stimulation.‡
Strength of Galvanic Stimulus in Milliamperes.

Dog No.	Duration	Right Leg (Denervated). Gastrocnemius-Plantaris. CCC§	ACC‖	Tibialis Anticus. CCC	ACC	CCC	ACC	CCC	ACC	CCC	ACC	Left Leg (Control). Gastrocnemius-Plantaris. CCC	ACC	Tibialis Anticus. CCC	ACC	CCC	ACC	CCC	ACC	CCC	ACC
69	95	1.2	1.9	1.8	1.9	....	....	1.1	1.3	2.0	1.3	2.1	2.1	3.1	2.9	0.9	1.6	1.7	2.1	2.7	2.3
66	117	4.0	4.3	3.7	4.5	3.7	3.9	2.5	3.2	4.0	4.0	3.0	1.7	1.3	3.0	1.0	2.5	1.3	1.3	1.3	1.3
44	149	2.9	3.2	3.3	4.0	2.3	2.5	3.0	3.3	3.1	4.0	2.1	2.6	2.5	3.1	1.6	1.8	2.0	2.1	2.4	3.0
15	257	2.1	2.3	3.0	3.1	1.2	2.1	2.0	2.6	2.1	3.2	1.8	2.2	2.3	3.0	1.1	1.4	1.4	2.1	2.0	2.6
4	290	1.6	2.0	2.2	3.1	1.1	1.6	2.1	2.7	3.1	4.1	1.1	3.5	1.3	4.1	1.2	1.5	2.4	2.5	3.4	4.5
3	289	1.3	1.7	1.1	2.4	1.1	2.1	1.2	2.4	2.4	2.2	1.8	2.2	2.0	3.0	2.1	2.7	1.6	3.2	2.4	3.1
Total		13.1	15.4	15.1	19.0	9.4	12.1	11.9	15.5	16.7	18.8	11.9	14.4	12.5	19.1	7.9	11.5	10.3	13.3	14.2	16.8
Average percentage		2.2	2.6	2.5	3.2	1.9	2.1	2.0	2.6	2.8	3.1	1.9	2.3	2.1	3.1	1.3	1.9	1.8	2.2	2.4	2.8
Difference		15.7	13.0	19.0	3.2	46.1	10.5	11.1	18.1	16.6	10.7	....	....	....	....	....	....	....	....	....	....

* In group II immobilization was not employed after denervation.
† Thresholds for faradic stimulation vary directly with the numerical position of the secondary coil.
‡ Thresholds for galvanic stimulation vary directly with the numerical value of the milliammeter readings.
§ CCC, cathodal closing contraction.
‖ ACC, anodal closing contraction.

Similar data are shown in table 2 for the animals of group II (those with nonimmobilized muscles). The qualitative relationships were practically the same in that there was a persistent elevation of threshold for both faradic and galvanic stimulation at the end of the recovery period. The threshold values for the anterior tibial muscles were consistently higher for both galvanic and faradic stimulation than they were for the gastrocnemius-plantaris muscles. Here, again, the greatest elevation of threshold at the end of the recovery period was in the nerve fiber. The average per-

centage difference in this group for faradic thresholds ranged from 27 to 112. Similar determinations for the galvanic current showed a percentage increase difference ranging from 3.2 to 46. A comparison of the threshold values for cathodal closing contractions and for anodal closing contractions shows the latter to be higher than the former in almost every instance in both the right and the left leg muscles.

Data pertaining to the irritability of the tissues in terms of time (milliseconds) for different voltages are shown in table 3. Time responses are shown for the different tissues of the normal and the denervated leg. Four dogs were included in the group (group III). The duration of the recovery

Table 3. — *Chronaxies and Time Response Measurements for Strength-Duration Curves.*

Dog No.	Duration	Subject*	Nerve R†	Nerve 1.3R‡	Nerve 1.6R‡	Nerve 2.R§	Nerve 3.R‡	Motor Point R	Motor Point 1.3R	Motor Point 1.6R	Motor Point 2.R	Motor Point 3.R	Muscle R	Muscle 1.3R	Muscle 1.6R	Muscle 2.R	Muscle 3.R
38	213	R-GP	.....	....	....	....	.....	14	10.5	6	3	0.9	20	11	7.4	3	0.6
		L-GP	.....	....	....	....	.....	14.2	5	0.2	0.07	0.04	14.5	5.5	0.26	0.2	0.12
		R-TA	12.5	3.0	1.6	0.3	0.17	13	1.9	1.1	0.5	0.2	18	10	5.4	2	0.18
		L-TA	5.5	1.0	0.3	0.1	0.04	6	0.7	0.2	0.11	0.08	10	2.4	0.2	0.18	0.09
68	64	R-GP	.....	....	....	....	.....	.....	....	....	....	.....	.....	....	....	....	.....
		L-GP	.....	....	....	....	.....	15.4	1.1	0.5	0.2	0.06	17.4	1.2	0.4	0.3	0.08
		R-TA	.....	....	....	....	.....	.....	....	....	....	.....	.....	....	....	....	.....
		L-TA	10	0.5	0.3	0.1	0.04	12	0.6	0.5	0.35	0.1	11	0.4	0.3	0.11	0.05
3	289	R-GP	.....	....	....	....	.....	3	10	6	1	0.5	5.6	50	20	5	0.5
		L-GP	.....	....	....	....	.....	3	50	20	11	6	5.6	30	3	0.2	0.07
		R-TA	2.5	6	3	0.6	0.2	3	4	2	0.4	0.2	4	30	10	2	0.6
		L-TA	2.0	8	4	0.7	0.2	1.1	2	1	0.3	0.1	3	30	4	1.0	0.04
4	290	R-GP	.....	....	....	....	.....	3.2	10	6	0.9	0.5	8	5	2.5	0.5	0.2
		L-GP	.....	....	....	....	.....	1	5	2	0.7	0.02	2	2	4	0.2	0.12
		R-TA	2	19	7	0.5	0.1	3.1	12	6	1	0.5	4.5	9	3	0.6	0.1
		L-TA	1	4	3	0.5	0.1	2	3	7	2.5	0.5	1	5	2	0.7	0.2

* R, right; L, left; GP, gastrocnemius-plantaris muscle; TA, tibialis anticus muscle.
† R, rheobase in volts.
‡ 1.3R, 1.6R, 2.R and 3.R are for strength-duration curves, and the numerical values are milliseconds.
§ 2.R, chronaxie in milliseconds.

period was 64, 213, 289 and 290 days, respectively. It will be noted that in each animal the voltage for the rheobase readings was higher for the tissues of the denervated leg than it was for the normal leg. The values for muscle were invariably higher than those for the motor point and nerve. The rheobase values for the motor point were higher than those for nerve fiber. The chronaxies, illustrated in the table as 2.R, showed in most instances higher values for the tissue of the right leg than for those of the control leg. The chronaxie at the motor point of the anterior tibial muscle in dog 4 was greater in the normal leg than in the denervated leg. Chronaxies after regeneration ranged from 0.3 to 0.9 millisecond for the nerve, from 0.4 to 3 millisecond for the motor point and from 0.5 to 5 millisecond for the muscle. Except for dog 4, the chronaxies were higher for the motor point and muscle tissue of the gastrocnemius-plantaris than for anterior tibial muscles.

We found the results of the chronaxie and strength-duration determinations to be so inconsistent that it was seldom possible to check them on subsequent readings. The results were so erratic that the measurements were regarded as not trustworthy. The measurements were made on a sufficient number of animals to convince us of their questionable value in experiments dealing with the measurements of irritability of tissues during and after peripheral nerve degeneration. Therefore, determinations of chronaxie and strength-duration curves have been discontinued in our experiments.

The average percentage difference in threshold between experimental and control muscles of group I and group II animals is shown in figure 1.

It will be observed that in both groups the threshold for faradic stimulation of the gastrocnemius-plantaris muscles was only 30 to 40 percent increased from the normal value, while, in the anterior tibial muscle the percentage increase ranged from 40 to 120 percent. In both groups the threshold for the nerve fibers was considerably greater than for the motor point and muscle tissue. The threshold for faradic stimulation was somewhat lower for both the gastrocnemius-plantaris muscles and the anterior tibial muscles for the tissues of group II (nonimmobilized muscles). The one exception was in the case of the motor point of the anterior tibial muscle, for which the percentage difference was 80 percent greater in group II as compared with 40 per cent in group I.

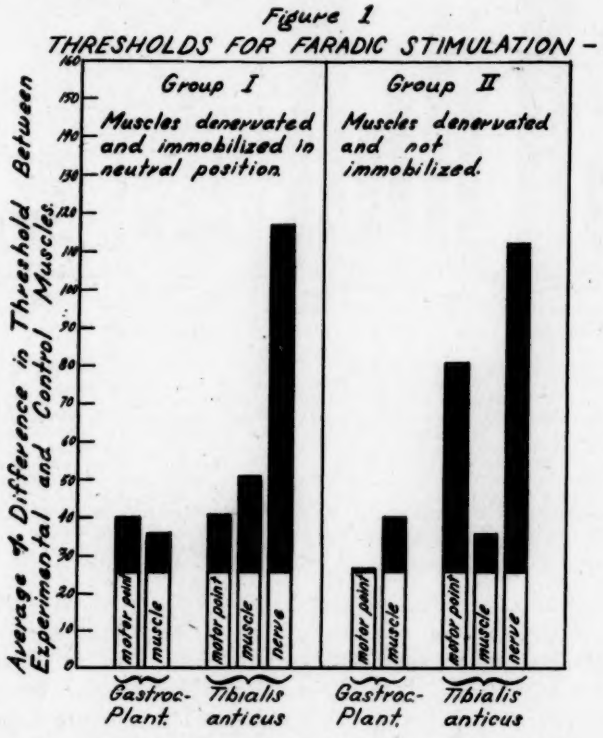

Fig. 1. — The average percentage difference in threshold for faradic stimulation between the experimental and the control muscles of the animals of group I and group II. In group I the muscles of the right hind leg were denervated and immediately immobilized. In group II comparable muscles were denervated but were not immobilized, protected or treated after denervation. The graphs illustrate the greater increase in threshold for the anterior tibial muscle as compared with the gastrocnemius-plantaris muscles and the slightly greater increase in threshold for the nerve and motor point of the immobilized denervated muscles.

Figure 2 shows the average percentage difference in threshold between the experimental and the control muscles of group I and group II when galvanic current was used for stimulation. In group II the electrical reactions of the tissues of the denervated leg were only slightly above normal, the increase being from 5 to 20 percent. The nerve fiber, however, showed an elevation of threshold amounting to 45 per cent. A comparison of the values for the two groups of animals shows a decided difference between the electrical responses. The percentage difference between the threshold values for the normal muscles and for the muscles which were immobilized after denervation showed an increase ranging from 32 to 227 percent. The thresholds for the nerve, motor point and muscle were invariably higher in

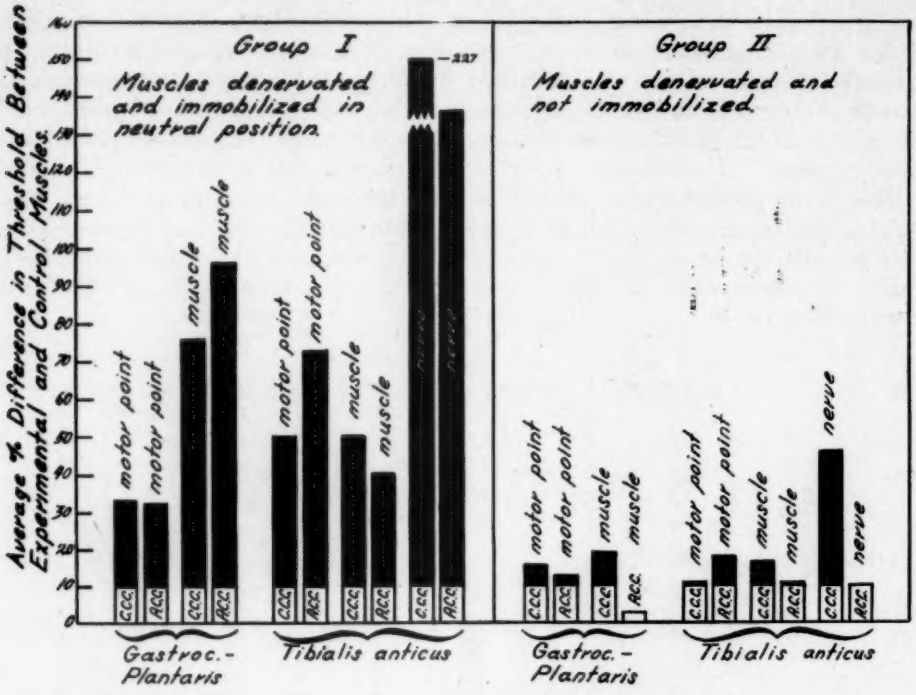

Fig. 2. — The average percentage difference in threshold for galvanic stimulation between the experimental and the control muscles of the animals of group I and group II. The thresholds for cathodal closing contraction (*C.C.C.*) and anodal closing contraction (*A.C.C.*) are indicated for the motor point, muscle and nerve trunk (to the anterior tibial muscle). In group I the muscles of the right hind leg were denervated and immediately immobilized in neutral position. Immobilization was continued during the entire regeneration period. In group II the denervated muscles were not immobilized. The average differences in the threshold values are shown for the gastrocnemius-plantaris and for the anterior tibial muscles. The graphs show that the electrical reactions of the tissues of group II were practically normal, while those of group I (immobilized muscles) were considerably increased above those of normal tissue (a 32 to 22 per cent increase). A marked difference in the threshold irritability of the tissues of the two groups is clearly portrayed by the graphs.

the animals in which the muscles were immobilized. The difference in the threshold values, except for the muscle itself was greater for the anterior tibial than for the gastrocnemius-plantaris muscles. It is apparent from the values shown in figure 2 that the irritability of the muscle, the nerve and the motor point was lower in the tissues that were immobilized than in those that were not immobilized after denervation.

Summary and Conclusions

1. Threshold values for faradic and galvanic stimulation of the nerve trunk, motor point and muscle fiber were determined on two groups of dogs after denervation of some of the muscles of the right hind leg. Terminal measurements of the irritability of the tissues were made after recovery periods ranging from 95 to 290 days. Chronaxie and strength-duration curves were made for a series of 4 animals similarly treated (group III). The recovery periods ranged from 64 to 290 days. In each instance, the antagonistic muscles of the right hind leg were denervated by crushing the anterior nerve roots of the fifth, sixth and seventh lumbar and the first sacral vertebrae. Threshold responses were determined for the nerve supplying the anterior tibial muscle and the motor point and muscle fiber threshold for the anterior tibial and gastrocnemius-plantaris muscles. Similar determinations made on comparable tissues of the left hind leg of each animal were used as controls. In two groups of animals (groups I and III), the muscles were immobilized in neutral and flexion positions and immobiliza-

tion was maintained during the entire recovery period, while in the other group (group II) no immobilization or treatment of any kind was employed.

2. The threshold value for normal tissues for both faradic and galvanic stimulation was consistently highest for muscle tissues, intermediate for the motor point and lowest for the nerve trunk. The quantitative values for the right leg (denervated muscles) were consistently higher than those for the left leg (normal muscles).

3. The neuromuscular apparatus of all animals after a recovery period ranging from three to almost ten months showed a partial reaction of degeneration. The threshold for faradic stimulation was relatively higher than that for galvanic stimulation. The average percentage difference between the threshold for faradic stimulation of the tissues of the right and of the left leg ranged from a 25 to a 117 percent increase. The thresholds for faradic stimulation of the tissues were qualitatively similar in group I and group II; the quantitative values were slightly greater for the immobilized muscles, and the thresholds as a rule were more increased for the anterior tibial muscle than for the gastrocnemius-plantaris muscles.

4. The thresholds after degeneration and partial recovery were consistently higher for nerve tissue than for the motor point and muscle tissue.

5. The thresholds for galvanic stimulation were higher for the tissues of the denervated leg than for those of the normal leg; the thresholds for anodal closing contractions were higher than for cathodal closing contractions and no polar reversal was present in any of the animals at the end of the period of regeneration.

6. The thresholds for galvanic stimulation for the animals of group I showed a percentage difference that ranged from 40 to 227.

7. Data for the animals of group II (those with nonimmobilized muscles) were qualitatively similar to those for group I (animals with immobilized muscles). The quantitative values for the thresholds for galvanic stimulation were consistently lower for the nonimmobilized denervated muscles. The thresholds for galvanic stimulation were qualitatively similar in the two groups, but the quantitative values were considerably less for the nonimmobilized denervated muscles.

8. Chronaxie measurements and strength-duration curves were found to be unreliable and unsatisfactory methods for determining the irritability of neuromuscular apparatus during the recovery period of nerve regeneration.

9. The return of irritability toward normal was consistently slower in the anterior tibial than in the gastrocnemius-plantaris muscles.

10. The irritability of tissues which had been immobilized during the recovery period after denervation was found to be consistently less than that of similarly denervated muscles which were not immobilized.

It may be concluded that immobilization was of no value in hastening or facilitating the return of irritability of peripheral neuromuscular tissues after denervation. Furthermore, it may be said that so far as electrical reactions are concerned, immobilization of denervated muscles retarded rather than hastened the return of irritability of the tissues.

Discussions will appear in a later issue.

PHYSICAL RESTORATION IN VOCATIONAL REHABILITATION *

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"Rehabilitation" has almost overnight become one of the most popular catchwords in medicine and, for that matter, in half a hundred other fields. Every one is talking about it and, unlike the weather, thousands of people are eager to do something about it. All this talk and action, from the vast international plans of the United Nations Relief and Rehabilitation Administration to the neighborly interest of the village service club in furnishing an artificial leg to the boy disabled in last week's harvesting accident, give one pause. What does all this enthusiasm for rehabilitation really mean? Have we not for many years been furnishing handicapped persons with community assistance to enable them to become self-supporting? One might almost think that we had only just discovered that many among us cannot secure satisfactory employment without special medical treatment, education, training and placement in appropriate employment. We should particularly like to know whether this new-found enthusiasm for community responsibility toward the disabled is going to disappear as suddenly as it has arisen, or whether we have at last come to understand that society can achieve its highest level only if every member contributes to it with the fullest physical, mental and emotional vigor of which he is capable. Perhaps one can hardly expect that such an intense interest will be maintained indefinitely, yet there is little doubt that it has already done much to make us all—physicians, educators, industrialists, workers, farmers—examine our inadequacies and resolve never again to be content to cast aside as useless our fellow citizens simply because they are blind, deaf, crippled, tuberculous or emotionally disturbed.

Of course our interest has been aroused by the war emergency and by the two fold emphasis its places on disablement: (1) the problem of bringing back to happy and useful living the men and women injured by wounds or disease in their country's military service and (2) the problem of bringing every ounce of energy of each one of us into its most needed place in war production. Our military services have led the way in showing us how the wounded and ill can be brought back to full activity with a speed and efficiency that seems nothing short of miraculous when we remember our hesitancy and indecision in reconditioning the patients in our civilian institutions. The Veterans Administration, under Public Law 16, is developing an extensive and systematic rehabilitation service for our soldiers and sailors discharged with service-connected disabilities. From these splendid accomplishments, we must take inspiration to meet the permanent challenge facing us in the host of civilian disabled, who are now so sorely needed in our war economy and who can have, if properly served, just as much to contribute to our victorious and enduring society.

It has become fashionable lately to measure the accomplishments and potentialities of rehabilitation services purely in economic terms. It is, of

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course, undoubtedly true that the community saves far more than it expends by assisting handicapped people to productive occupation. For example, the 79,000 persons rehabilitated by the state rehabilitation agencies in the last three years were receiving before rehabilitation public relief amounting to $3,500,000 anually. Average yearly earnings among the group were $110 each. The same group after rehabilitation were earning an average of $1,225 apiece annually as a result of the vocational guidance and training, use of prosthetic appliances and, to a small extent, the physical restoration services they had received. So, instead of draining our economy of $3,500,000 in public funds each year, they are now contributing to it about $100,000,000 worth of their labor. That is really turning tax consumers into taxpayers.

Yet surely we can find a more valuable purpose in rehabilitation than simply dollars and cents. Surely the community has an obligation not only to make use of each of its members to the greatest extent possible but to see that each member has a decent opportunity to enjoy the fruits of his labor—to live in happiness and security so far as he is capable of it, to meet the future with courage and self reliance and to benefit fully from modern achievements in medicine and other sciences, in education, housing, nutrition, recreation. This, we can all agree, is the ultimate goal of rehabilitation of the disabled, and it is this which faces us as the long range challenge, not only of the war, but of the larger and more enduring problem of the civilian disabled who are everywhere among us.

As a matter of fact, the states with limited federal aid have been attacking this problem for close to twenty-five years, ever since the passage of the Federal Vocational Rehabilitation Act in 1920. Under this legislation, vocational rehabilitation agencies were established in each state, the District of Columbia, Hawaii and Puerto Rico. The following services were furnished to physically handicapped persons: vocational guidance and training, the providing of prosthetic appliances and placement in employment. The federal share of the cost was limited to $3,500,000 annually to match state expenditures for administration and case services. Physical restoration services (medical-hospital care, physical and occupational therapy, etc.) were not included, nor were there federal funds for the maintenance of disabled persons during training. The mentally handicapped could not be served, and there were no special services for the blind. In twenty-three years of activity under this somewhat limited program, 210,000 handicapped persons were rehabilitated, 42,000 of them in the 1943. This was an excellent accomplishment, but it fell far short of the real need, and the lack of physical restoration services meant that it was often necessary to "train around a disability" that could have been remedied by appropriate medical or surgical treatment.

The most reliable estimate of the number of handicapped persons in the United States is that derived from the national health survey conducted by the United States Public Health Service in 1936. According to these figures there were in that year 23,000,000 persons in this country with physical disabilities affecting their employability. Of these 16,000,000 were between the ages of 16 and 64, evenly divided between the sexes. Thus, there were 8,000,000 men of working age with significant employment handicaps, somewhat more than 6,000,000 of whom were considered able to secure suitable employment in ordinary industry or agriculture merely through good vocational guidance and selective placement. Of the remaining 2,000,000, about 500,000 were thought to be too severely handicapped to do more than limited work at home or in sheltered workshops even after receiving rehabilitation services, with a residue of 1,500,000 men who could be rehabilitated for ordinary industry and agriculture if rehabilitation services were available. Furthermore, it is known that about 800,000 additional persons are

permanently disabled annually, 100,000 of them so severely injured as to require rehabilitation services before they can be satisfactorily employed.

Faced with this large group of potentially useful citizens and with an urgent need for manpower for war production, Congress decided to broaden and strengthen the nation's vocational rehabilitation services and passed in July 1943 Public Law 113, the Vocational Rehabilitation Act Amendments, also known as the Barden-LaFollette Act. At the same session Congress passed Public Law No. 16, under which the Veterans Administration administers a separate program for the rehabilitation of veterans with service-connected disabilities. There has been some confusion in the public mind on this point, and I think it would be well to remember that in the remainder of this paper I shall be referring to the program under the Barden-LaFollette Act, primarily for the benefit of disabled civilians, including veterans with non-service-connected disabilities.

Under the terms of this act, we have, as a permanent part of the nation's organic law, a broad framework for the vocational rehabilitation of all handicapped persons. The fundamental purpose of the program is to prepare for and place in remunerative employment those persons who are handicapped for employment because of permanent disabilities caused by accident, disease or congenital defects. The responsibility for the administration, supervision and operation of the program rests with the state boards of vocational education, each having a division of vocational rehabilitation, and the state agencies for the blind. The federal office, the Office of Vocational Rehabilitation in the Federal Security Agency, is responsible for the certification of federal funds, for the establishment of standards and for technical assistance to the states. The scope of services available to disabled persons has been broadened to include any services necessary to render them capable of engaging in remunerative employment or to render them more advantageously employable. These may include medical and surgical diagnosis and treatment, hospitalization, physical therapy, occupational therapy, the supplying of prosthetic appliances, vocational guidance and training, maintenance during training, placement in employment and other necessary services. Fortunately, the act has been written so as to include the mentally as well as the physically disabled. Specific provision has been made for the blind, for civil employees of the United States government injured in the performance of their duties and for war-disabled civilians, including civilian defense workers and merchant seamen injured in line of duty. Grants to the states for rehabilitation services are now to be based on the actual requirements of their case loads and on the amount of state funds available for matching. Moreover, the federal government assumes the entire cost of administration of the state programs. The cost of medical examinations, medical and surgical treatment, vocational training, occupational tools, transportation and maintenance is shared by the federal and state governments on a fifty-fifty basis, except that total expenditures for rehabilitation services for war-disabled civilians will be reimbursed by the federal government.

The state vocational rehabilitation agencies which have heretofore been limited to vocational guidance and training and the supplying of prosthetic appliances as the only services for which federal aid was available have, therefore, now the opportunity to do a complete rehabilitation job. In providing physical restoration services, it is intended to utilize existing public and voluntary health agencies in the community, and an important share of the physical restoration services will be carried out in voluntary and public hospitals, clinics and special centers.

The federal Office of Vocational Rehabilitation has been established by the Federal Security Administrator as a constituent unit of the Federal Se-

curity Agency, and it is directed by Michael J. Shortley. Through a cooperative arrangement between Mr. Shortley and the Surgeon General of the Public Health Service, medical officers of the Public Health Service have been assigned to the Office of Vocational Rehabilitation to head the plans for physical restoration. Besides the chief medical officer, the federal physical restoration staff now includes Dr. Jack Masur, who is an experienced hospital administrator, Dr. Victor H. Vogel as psychiatric consultant and Dr. Frank F. Furstenberg, who is to serve in the regional office in San Francisco. It is anticipated that shortly the staff will be augmented by a consultant in tuberculosis and by two more medical officers to serve in regional offices. Miss Marian Russell, formerly Executive Secretary of the American Association of Medical Social Workers, is the medical social work consultant.

A national Professional Advisory Committee has been appointed and includes representatives of the various fields of medicine concerned with rehabilitation and representatives of hospital administration, medical social work, public health nursing, physical therapy and occupational therapy. Among the members of this committee, which has met and worked with diligence on the federal policies and recommendations regarding physical restoration, are Dr. John S. Coulter and Dr. Carl M. Peterson, both of Chicago. The technics of physical therapy and occupational therapy are represented, respectively, by Miss Catherine A. Worthingham, of Palo Alto, Calif., and Miss Marjorie Fish, of New York. Miss Bell Greve, of Cleveland, is a member of the national over-all Rehabilitation Advisory Council, which guides the federal office with respect to all phases of the vocational rehabilitation program.

As has already been mentioned, the state vocational rehabilitation agencies and agencies for the blind may now provide a broad range of services for handicapped persons, one of which is physical restoration. It is important to recognize, however, that the handicapped cannot be properly served by medical services alone. It is essential that these services be carefully coordinated with the other services the individual may require, such as vocational guidance and counseling, vocational training, maintenance, transportation, the furnishing of occupational tools and equipment and placement in suitable employment.

As a basic requirement for rehabilitation, the federal regulations call for a complete medical examination in every case as a part of the determination of eligibility for service. This examination is to include not only a good medical history and physical examination, but all necessary specialist examinations and laboratory tests. The medical examination is to be provided whether or not it is anticipated that physical restoration services will be needed. It is obviously just as important to know the physical condition of the client in order to give him satisfactory vocational guidance and training as it is to determine the need for some surgical procedure.

If it has been determined that physical restoration is required, there is in the federal act no limitation as to the scope of the physical restoration services which may be provided. They may be medical services, surgical services, hospitalization up to ninety days, convalescent home care, physical therapy, occupational therapy, work therapy, speech therapy, nursing in the home, office, clinic and hospital, drugs, dental care for employment handicaps, etc. There are, however, some limitations or definitions as to the types of cases which may be brought into the picture.

In the first place, the individual must have a disability which is a substantial employment handicap.

Second, for physical restoration services, the disability must be a static one. The intent of Congress in using the word "static" here was to differ-

entiate the rehabilitation program of physical restoration from ordinary medical care for acute illness or injury. In general, the word "static" is taken to mean any disability that is relatively stable or slowly progressive. A person with chronic glaucoma, for example, would not have to wait until blindness had occurred before treatment could be provided.

The third limitation is that the disability, in addition to being an employment handicap and static, must be such that by appropriate treatment it may be expected to be substantially reduced or eliminated within a reasonable period of time. The phrase "within a reasonable period of time" clearly is intended by Congress to distinguish this program from the long term care of chronic illnesses that do not improve very much. The emphasis is thus on reconstruction for employment—filling a gap in our publicly supported medical care programs that has sadly needed filling for a long time.

Finally, there is a fourth limitation, of a somewhat different character: that physical restoration services may be provided at public expense only so far as the individual is unable to pay for these services in whole or in part from his own resources. The basic medical examination, however, and the services of vocational guidance and counseling, vocational training and placement may be furnished without cost to the client, regardless of his financial resources.

This pattern follows the traditional pattern in our states; that is, vocational training, which corresponds to public education, is available to all without regard to financial resources, whereas public medical service, as is generally true, is made available only on a needs basis.

Briefly, the program is being administered in the following manner: There are fifty-one state boards of vocational education, including those of the District of Columbia, Hawaii and Puerto Rico, and thirty-one state agencies for the blind, so that the national office is dealing in this program with eighty-two separate state agencies. Where there is no state agency for the blind, services for that group also are provided by the state board of vocational education.

A few fundamental administrative requirements regarding physical restoration have been set forth by the federal office with the concurrence of the national Professional Advisory Committee. In the first place, the states are required by the federal standards to have in each state agency a supervisor of physical restoration. This person will presumably be a worker with experience in the medical field but not usually a physician. The position could be filled by a nurse, medical social worker, clinic administrator or some other person who has worked in physical restoration or in a health or medical care program.

In the second place, each state agency is required to have a physician as medical (administrative) consultant, full or part time. Presumably most of these will be part time.

Third, there is required a medical social work consultant, full or part time; and, fourth, there is to be a state professional advisory committee, which is to include representatives of medicine, public health, nursing, hospital administration ,etc. The object of this committee is to meet occasionally with the state agency on general matters and to assist the state agency in determining over-all policy. The functions of the medical administrative consultant are the day by day consultation which will be required in passing judgment on case applications, implementation of standards and advising and training other sections of the state staff, especially on matters concerned with the medical aspects of vocational guidance, training and placement.

In furnishing physical restoration to the disabled, it is obviously essential that the highest possible standards of professional care be utilized. If an

inferior piece of work is done, the handicapped individual may well find himself more seriously disabled after an operation than before. The state rehabilitation agencies are, therefore, being encouraged to select the best qualified physicians, surgeons and technicians and the leading public and voluntary hospitals. It is probable that most of the treatment services under these programs will be specialty services. By and large, the types of disability which are employment handicaps, which will be reckoned as static and which are remediable will require the service of the specialties, such as orthopedics, physical medicine, ophthalmology, tuberculosis therapy and psychiatry. So we have concentrated, in the standards required of the states, on the specialty services. General medical examinations may be done by any physician licensed to practice medicine and surgery, but the specialty standards are stricter. So far as possible, in the specialties in which American Medical Association specialty boards exist, the states are asked to use physicians certified by these boards.

Where there are real shortages of certified specialists, physicians who have met the experience and education requirements for admission to the specialty board examinations may be considered for use as specialists. With regard to specialties in which there are no specialty boards—and there are quite a few of these, for example, physical medicine—the states are asked to draw up their advisory committees standards which will show the federal office how they will choose their specialties. Finally, provision is made that individual specialists may be approved by the state advisory committee in certain instances.

The standards for physical therapy and occupational therapy technicians recommended by the federal office for use by the state agencies are registration in the national registry and graduation from a school approved by the Council on Medical Education and Hospitals of the American Medical Association.

With regard to hospitals, the states are limited except in special instances to the use of hospitals approved by the American College of Surgeons. The recommendations regarding hospitals go further. It is recommended that hospitals of over one hundred beds be used where available, especially those which have well developed medical and nursing specialty services, medical social service, occupational therapy and physical therapy. It is further recommended that, so far as practicable, a hospital approved for residency by the American Medical Association in a given specialty be used for patients requiring treatment in that specialty.

There is one other point which might be of interest, namely, the way in which physicians, nurses, physical therapy technicians, occupational therapy technicians, hospitals, etc., may be paid for their services under this program. The Federal Manual of Policies says that the states may choose whatever methods they wish for paying physicians, nurses and other professional personnel. They may be employed on full or part time salary, or they may be utilized on the basis of fees paid per case, per visit or per day. They may also be utilized through payments to clinics, hospitals, visiting nurse associations, special rehabilitation centers or other official and voluntary agencies which have such persons on their staffs, in whatever way the states may find most suitable under their particular circumstances. Salary scales and fee schedules, however, must be submitted to the federal office for approval, and fee schedules may not exceed those in use under crippled children's or workmen's compensation programs or those needed by the veterans administration or the United States Employees' Compensation Commission.

With regard to hospitals, it is required that payment be made on all inclusive per diem rates. It is not required that these rates be based on

cost, but it is recommended very strongly that payments be made on the reimbursable cost basis in use in the crippled children's program and in the emergency maternity and infant care program supervised by the Children's Bureau. We are recommending not a similar method of cost accounting but an identical one, so that a hospital participating in both of these programs would fill out but one form each year, sending one properly certified copy to the state health department for the emergency maternity and infant care program and another to the state board of vocational education for the rehabilitation program.

These are the principal provisions of the program, particularly those dealing with physical restoration. At present the program is small, but it is expected that rapid expansion will take place. It should be borne in mind that any person residing in the United States, including Hawaii and Puerto Rico, who has a disability that constitutes an employment handicap and who in the judgment of the state rehabilitation agency can be assisted to become employable or more advantageously employable through rehabilitation services may be eligible for the services he requires, subject, of course, to the standards and limitations mentioned previously. The philosophy of the program, just as is the case with that of the armed forces and the Veterans Administration, is to aid the disabled person to secure and retain suitable employment in a job at which he can hold his own, on his merits as a worker, in normal competition with other workers. Such jobs will be, for the most part, in ordinary industry, commerce and agriculture. In addition, however, the program seeks to rehabilitate the more seriously disabled for remunerative employment in shelterd workshops or at home.

The vocational rehabilitation program meshes well with, and in no sense duplicates, the work of other governmental and voluntary programs in similar or allied fields. For example, the Veterans Administration deals primarily with veterans having service-connected disabilities, while state rehabilitation agencies work with civilians, including, as necessary, veterans with non-service-connected disabilities. Similarly, crippled children's programs will continue to furnish physical restoration for children eligible for their services, and the rehabilitation agencies may assist the same children with vocational guidance and training when they reach employable age. When these children pass the age limit for crippled children's programs, they may, if necessary, receive further physical restoration from the state rehabilitation agencies. Workmen's compensation will, of course, continue to provide medical services and disability benefits for compensable injuries and diseases, but the rehabilitation agencies may furnish workmen with retraining when it is needed to secure satisfactory employment or may furnish physical restoration if the limitations on medical service under workmen's compensation are exceeded. In the same way, the services of state rehabilitation agencies and the United States Employment Service supplement each other. The employment service provides valuable aid in placing handicapped persons in suitable jobs, while the rehabilitation agencies supply medical examinations, physical restoration, vocational training and other services not ordinarily available through the employment service. Cooperative agreements have been worked out by the federal and state vocational rehabilitation agencies with these and other public programs carefully delineating the various functions to be undertaken by each, and the points at which their services will be closely integrated.

I should like to stress three further points. The first is the need of our state agencies for the assistance of physicians in finding cases and employment opportunities. Physicians in their daily work will often come across handicapped persons who need and can benefit from the services offered under this expanded program. Likewise, they will hear of positions which

could well be occupied by disabled persons of suitable aptitudes if they have been adequately restored physically and trained vocationally. I urge them not to miss the opportunity of referring such persons and job opportunities to the state rehabilitation agency or agency for the blind. We cannot succeed in our task unless we are made aware of all who need our service and unless we know of all available opportunities for employment.

Second, we need the earnest cooperation of physicians in furnishing professional guidance to our agencies. There is no necessity to emphasize that expert medical advice is essential at every stage in the rehabilitation of a handicapped person. Nor do I have to point out that in every field of therapy, medical supervision is required. Physical medicine will play a tremendous role in this program, and our agencies, in turn, can greatly assist in the development of physical medicine of high quality by intelligent use of physicians' services, with adequate remuneration for them. We have much to gain from each other. May I express the hope that each of you will offer all the aid you can to your state agency—by serving on its advisory committee, if desired; by serving, or helping to secure a well trained physician to serve, as the agency's medical administrative consultant; by performing thorough medical examinations on clients; by furnishing services needed in the training or physical restoration of the handicapped.

Finally, I come to what may ultimately be the most important development in medicine that this program may, in some degree, help to bring about. I mean, of course, new attitudes toward rehabilitation in medicine and in hospitals. Too many of us have been too easily satisfied with providing our particular kind of medical service, and have not given enough thought to how the patient's disability and our treatment of it are going to affect his future employment. These new military and civilian programs will do a lot to help us in the medical and hospital fields to remember that patients are part of the community and that when they leave the hospital they have to go out and contribute to our community life.

We shall also have to learn to start rehabilitation services early, preferably in a hospital bed, while the disability is still malleable and before the patient has begun to suffer the demoralization that comes from long periods of idleness. We shall have to learn to make the rehabilitation process a continuous one, so that from the time the disability arises from injury or sickness, the patient will go from medical treatment to physical therapy, to occupational therapy, to prevocational training, to vocational training, to placement in employment—or any combination of these—straight through as one continuous plan, and never have a chance to become dejected, humiliated and deteriorated through being dependent on others.

We are short of some facilities, it is true. Special physical training centers are badly needed. We are short on physical therapy and occupational therapy technicians and medical social workers, but we can still make a good start on many thousands of cases without taxing unduly our existing institutions and professional personnel.

What we need most is not new facilities but an understanding of how to use our present facilities well, not haphazardly, but in an intelligent and continuous manner. To begin at the beginning with the patient and go through with him to the time when he is employed again—that does not seem too visionary to me. This is the ideal time to learn to make effective use of what we now have—to get it to our patients early and to make rehabilitation a truly constructive process leading to satisfactory employment. Much will depend on what physicians, particularly in the field of physical therapy, do to help us and our patients, and we know that we can count on them for enthusiastic cooperation and intelligent guidance and for providing unstintingly professional services of the highest quality.

REHABILITATION IN THE NAVY *

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Expansion of the Navy and Marine Corps to their present size has brought with it a proportionate increase in the number of sick and injured from stations in the United States. Combat operations in far flung theaters have been followed by the inevitable toll of sick and wounded. All of these men must be restored as nearly as possible to normal health and well-being; they must be rehabilitated. As we understand the term, rehabilitation does not mean a separate procedure that is started at a certain time for a specified class of persons. On the contrary, it is a process that starts as soon as a sick or injured man comes to medical attention and continues until he has received the maximum benefit from treatment and is in condition to leave the hospital. It includes everything that assists in restoring him to a condition of health and ability to carry on his daily tasks, whatever they may be.

The medical and surgical care, both overseas and in this country, which constitutes such a large part of rehabilitation, has been discussed by others; this discussion is confined to that part of the rehabilitation process which supplements this treatment.

It is the long-standing policy of the medical department to retain in hospitals until convalescence is completed those patients who can be restored to duty, and to care for those who are too disabled for further service until they have received the maximum benefit from treatment. Patients, therefore, remain in our hospitals longer than they would in civilian hospitals for the same conditions. There is a considerable portion of this time during which their need for active medical or surgical attention is decreasing and they feel increasingly fit. Thus time can hang heavily on their hands.

The rehabilitation program in operation in our hospitals has been developed to take advantage of this situation. It is designed to give attention to the problems of recovery that go beyond treatment of the ailments that brought the patients into the hospitals, hasten their convalescence and enable them to prepare for gainful activity after they leave the hospitals. Many fields of endeavor are involved in this general program—physical therapy, occupational therapy, education and vocational counseling, physical training, recreation, social service in its broad meaning and, for those who return to civil life, assistance in their problems of readjustment. Morale is an intangible but often determining factor in recovery from illness whether the patient is in uniform or in civilian clothes. It is a factor of major significance in our work. Concern over conditions at home, worry as to the future effect of disabilities, the urge to get back into the fight so that victory will come sooner, the desire to become economically independent if future service is impossible—all have a bearing on how successful rehabilitation will be. Attention to morale starts during the admission examinations and interviews by the medical officer who is the patient's physician and is continued throughout the patient's hospitalization.

The program operates in the hospitals through a medical officer who

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has been designated as rehabilitation officer assisted by a board composed of medical and technical specialists. Since the program supplements the usual treatment procedures, it is guided at all times by the judgment of the medical officer responsible for the treatment of the individual patient as to when these auxiliary activities should be introduced and which ones will contribute most to recovery.

Physical medicine, which we interpret to include both physical therapy and occupational therapy, is a phase of the program that is, in fact, a part of the professional treatment. The important part physical therapy plays in a properly rounded out treatment scheme has long been recognized in the Navy. The physical therapy department is an essential feature built into all Naval hospitals in this country, and less elaborate installations are a part of our temporary overseas hospitals. Equipment for certain forms of physical therapy is standard in our hospital ships and other large ships of all types. Some of the hospitals in this country have extensive physical therapy departments, and it is our practice to send to them the patients expected to benefit most from the treatment they are equipped to give. Some of the hospitals which were originally hotels or resorts have facilities installed as recreational features which today are performing a more practical service in physical therapy.

Physical therapy is always under the direction of a medical officer, and in the larger hospitals medical officers trained in physical medicine head this department. Physical therapy technicians or nurses trained in this specialty, assisted by qualified technicians, conduct the treatment.

The prediction is being borne out that physical therapy will be brought to the fore in this war as orthopedic surgery was in the last. It is being employed for an increasingly wide range of conditions, particularly conditions other than surgical. This more extensive use of physical therapy can only indicate that the medical profession, as represented by our medical officers, has learned that the patient's course toward recovery is more pleasant and more rapid when an appropriate form of physical therapy is part of the plan of treatment.

Occupational therapy is another treatment procedure utilized to promote recovery from physical impairments and to aid in bringing about a healthy mental outlook. It is brought to the bed patient in the ward when ordered by the physician and continued in the workshop for ambulant patients. The procedures employed are limited only by the ingenuity of the occupational therapy technician in making use of the facilities available in the hospital. As a general rule, we prefer that the tasks selected have a definitely practical significance whenever possible. Many Navy procedures and many of the processes of industry require use of muscles and joints which can be adapted to the purposes of therapeusis. By judicious selection of the procedure to be employed, the technician can materially decrease the necessity for teaching patients skills that are new to them and can concentrate on obtaining the desired therapeutic result. The value of the various arts as therapeutic undertakings in certain types of cases is fully recognized, and we expect our technicians to make full use of them when they are indicated. The occupational therapy technician is expected to give consideration to the probable course of the patient after he is discharged from the hospital and when possible to select procedures that will assist in this. The accent in occupational therapy is placed on the therapeutic effect anticipated from the activity assigned; any skill the patient may acquire or any article of value he may produce is considered incidental to the treatment procedure.

Occupational therapy activities in our hospitals are always under the

direction of a medical officer, but the direct supervision of the work with the patients is carried on by trained occupational therapy technicians who have entered the Navy for duty in this specialty.

Physical conditioning is an important part of the process of recovery. It is generally recognized that inactivity for an appreciable period results in some degree of deterioration in the general physical fitness of healthy persons. The enforced inactivity of bed rest, combined with the direct results of disease or injury, produces a greater and more rapid deterioration among patients. The necessity for overcoming this is one of the factors contributing to prolonged convalescence. An organized program of graduated exercises is now under development as one means of preventing as much of this loss as possible and hastening return to an optimum state. Exercise will be graded from very mild forms suitable for bed patients through all grades of intensity to that suitable for the man who can engage in unlimited activity. Medical officers will designate the extent to which their patients participate, but the actual work will be carried on by Naval personnel trained in physical education.

Training, education and counseling are important features of the rehabilitation program—training and education particularly for men who will be returned to active duty. Many patients enter the hospitals from nearby duty stations because of acute conditions of short duration, but there is a considerable number, particularly those evacuated from overseas, who require prolonged periods of treatment. The type of training or educational project suitable for a particular patient must, therefore, he appropriate to his probable length of hospital residence. A large number of ingenious training devices developed for other purposes are extensively used in the hospitals, many of them by bed patients. Practical instruction is carried on whenever possible. Study and correspondence courses are available in a wide range of subjects for patients who will remain in the hospital long enough to justify their starting such projects. In addition to courses relating to Naval duties, there are courses in general education which may be undertaken by patients who desire to add credits to their previous academic records. Arrangements may be made for these students to receive credit from their civilian schools for their work. Courses of study which are prerequisite for promotion in enlisted ratings may be undertaken and the patient given full credit for successful completion. Classroom instruction is carried on whenever there are sufficient students of subjects suitable for this method of presentation. Posters, instruction films and printed material are widely used both for their training value and for orienting the men as to the progress of the war and the factors involved. The objective of whatever training or education is undertaken is to maintain or improve the patients' adeptness for the duties they will perform after they leave the hospital.

Educational and vocational counseling are an essential part of preparing for their return to civil life, men who must be discharged for physical disability. As soon as it is determined that a patient will not return to active service, the educational services officer reviews with him his total training and experience and learns his ideas for his postservice career. Physical and psychologic handicaps are evaluated by professional members of the staff. On the basis of this general survey, the patient is assisted in arriving at a decision which will be satisfying to him and at the same time be compatible with his handicaps. During the remainder of his hospital residence he is encouraged to engage in studies or in practical work which will be the ground work on which he will build after he leaves the service.

Many of these men enter the hospitals with well formulated plans for post-war careers with which their disabilities will not conflict. Some have former jobs waiting for them and are physically able to return to them. These men need only counseling as to the features of the educational program that will be of the greatest help to them. Others, however, either have no plans or must alter their plans because of their disabilities. Counseling for these men is directed toward aiding them to develop a plan for their future and advising the appropriate type of educational pursuit. All that is done to prepare these men for civil life is coordinated with such civilian agencies as the Veterans Administration and the Veterans Employment Service. Our objective is to assist each man to prepare a plan for his future and start him on a course of action in the hospital that will be continued in civilian life with a minimum loss of time.

The many rights and benefits provided for veterans are fully and accurately explained to men being discharged for physical disability by officers especially trained for this duty. These officers also make the necessary arrangements for effecting the man's plans for his civilian adjustment, coordinate the efforts of the representatives assigned to the hospitals by the agencies and organizations interested in the welfare of veterans, and make sure that claims for benefits are properly completed and promptly forwarded. In addition to these services prior to discharge, further consultation and aid from the civil readjustment program in operation for all men discharged from the Navy is available during the first months in civil life.

Recreation, an essential part of any well ordered life, assumes increased importance during hospitalization. This has not been lost sight of, and extensive programs of healthful recreation are conducted by trained personnel. All hospitals have well stocked libraries under the direction of professional librarians. Assortments of books are brought to the wards at frequent intervals for patients who are unable to go to the reading rooms. Many hospitals have large libraries of musical recordings with special rooms where they can be played to the best advantage. Radio sets are available generally, and many hospitals have built-in head sets for use by bed patients. Movies are a routine, and a wide variety of entertainments, parties and dances are arranged.

Any discussion of the rehabilitation effort would be incomplete without mention of the very real contribution to the welfare and contentment of the patients being made by the American Red Cross. Their workers perform innumerable personal services, such as taking care of correspondence for those unable to write, carrying out shopping missions and giving assistance in correcting unsatisfactory family or home situations. They provide diversional handicrafts for convalescent patients and bring entertainment and various kinds of recreational activities to patients confined to the wards. They assist men being discharged from the service in preparing claims for benefits under existing laws. The value of the friendly services of these workers is fully realized, and they are called on freely to aid in overcoming difficult situations which may be impeding recovery.

Since our hospitals are all general hospitals, these features of the rehabilitation program are common to all of them. Certain hospitals, however, have been designated to receive patients requiring special kinds of treatment or care, and in these the program includes special features.

Patients requiring plastic surgery are treated in the hospitals at Bethesda, Md., and Oakland and San Diego, Calif. Physical and occupational therapy come into play at appropriate times, and prosthetic appliances are made when necessary to compensate for some unavoidable disfigurement.

Patients suffering from rheumatic fever are transferred to the hospital at Corona, Calif., where rehabilitation work is directed toward preparing them for a suitable activity while they are recovering from this disease.

All patients with bilateral blindness are transferred to the Naval Hospital in Philadelphia as early in their blindness as possible. These patients are immediately started on social adjustment training while they are receiving any medical or surgical treatment that may be required. Their training starts with steps to bring about a healthy psychologic adjustment to the blindness, which in most cases has occurred suddenly rather than by gradual development. They are taught to care for their personal needs, how to eat properly, and how to move about freely unescorted; in short, how to live normally in spite of their disability. They are instructed in typing and are started on Braille. During their period of hospitalization, careful counseling as to their future is conducted, and they are given every opportunity and encouragement to prepare themselves for a satisfying, economically useful life. These men are not discharged from the service until they are fully ready to start on their careers, whether these involve further education or immediate employment. There is the closest cooperation between the Navy and the Veterans Administration in arrangements for the future of these men, so that the Veterans Administration is prepared to assume responsibility on the day the man is discharged from the service. The total number of the blind in the Navy is comparatively small—at the present time less than the capacity of an average-sized hospital ward—and in many of the cases the blindness has resulted from the hazards of everyday Naval life rather than from actual combat injuries. We have reason to hope that blindness will not be a greater problem numerically than it has been up to this time.

All patients with bilateral deafness of more than a standard degree are also concentrated at the Naval Hospital in Philadelphia. Particular attention is given to the psychologic problems involved in these patients' adjustment to their handicap while they are being taught lip reading and correct habits of speech. Hearing aids to meet the requirements of the individual case are fitted during the final stages of treatment, and the appropriate instrument is furnished and the patient trained in its use before he leaves the hospital.

Patients who have undergone amputation of an extremity are treated either in the Naval Hospital, Mare Island, or the Naval Hospital, Philadelphia. The surgical treatment necessary to prepare the stump for prosthesis is carried out in one of these centers. Both of them have complete shops operated by craftsmen in the manufacture of artificial limbs. A temporary appliance is furnished the patient as soon as his stump is in condition to receive it. This is later replaced by a permanent type of prosthesis, which the patient is taught to use satisfactorily before he is discharged from the hospital.

As part of the training in use of the appliance, the patients are given opportunities for actual trial in activities in which they may intend to engage after discharge. Many of the amputees, particularly men who have made the service a career, return to active duty of a limited nature as soon as their prosthesis is comfortable and they are able to use it; others go directly from the hospital into suitable employment.

The rehabilitation program is broad enough to extend to all patients in a hospital. The direction it takes in the individual case, however, depends on whether the patient will be returned to active duty or will be discharged to civil life.

It is necessary at this time that emphasis be placed on returning men to duty. The war is far from won, but the manpower resources of the nation have been strained to bring the armed forces to their present strength. The Navy and Marine Corps need every man now wearing a uniform. Time and effort have been expended in training these men. To lose one unnecessarily requires a needless call on the civilian community for a replacement for him and a wasteful repetition of the training effort in order to prepare this replacement for combat duty. During the training period, the replacement is not available for active service, and for that time there has, in effect, been the loss of the services of a man.

As a part of the effort to make maximum use of the manpower which has been drawn from civil life, men who have become unable to perform all the duties normally expected of them, but who are able to perform limited kinds of duty, may be retained in active service in assignments compatible with their handicaps. These men perform many essential duties and release the able-bodied for more active assignments. Prompt and complete medical and surgical treatment, fortified by appropriate parts of the program, is returning the majority of our patients to active service cured of their ailments, in good physical condition and with a minimal loss of adeptness for their usual duties.

Although emphasis is placed on returning as many men as possible to Naval duties, the Navy feels an equal responsibility to the men whose disabilities necessitate their discharge to civil life. The Surgeon General of the Navy expressed the broad aim of our effort for these men in his address before the American Medical Association last June in these words:

> The Navy has a definite feeling that its personnel who suffer casualties must be given every consideration, so that they may be returned to civil life in a manner that will enable them to secure employment. It can well be said that it is the duty of this Government to the men who have been damaged by war to make very sure that they are able to help themselves and are not led to believe that they must live on the money that will be doled out to them in a pension. True, they will have their disability allowance, but the Government must be sure to see to it that these men have the proper mental approach to the proposition that they must take a useful place in their local communities.

Although these men to whom the Surgeon General refers are no longer able to perform active Naval service, we know they have fruitful lives ahead of them in which they can make a full contribution to society. We can complete their physical rehabilitation before they are returned to civil life, but we can only lay the ground work for their social and economic rehabilitation. Their pensions and similar assistance will help to offset their physical handicaps, but they will need the intelligent cooperation of the communities to which they return in finding a place where they can best progress by their own efforts.

Rehabilitation of all casualties is accepted as a definite duty and responsibility of the medical department of the Navy. The program is actually in operation. There are many points which need perfection. Possibly things which should be done have been overlooked. Our goal has been set, however, and we are steadily moving forward.

PRACTICAL APPLICATION OF PHYSICAL THERAPY IN REHABILITATION *

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Physical rehabilitation in wartime is one of the major functions of the medical profession. Rehabilitation in modern warfare, in which the agencies for physical destruction are so explosively potent, resolves itself quickly to the treatment of trauma. Physical therapy needs no introduction in the treatment of trauma and holds an important place in various phases of physical rehabilitation. General surgery and, particularly, orthopedic surgery play the major roles in the treatment of war and industrial injuries. Physical therapy is one of their tools. The type of physical therapy, the time it is employed and the technic of its utilization are the factors which determine its ultimate value in a given case.

The physical therapy most commonly used is not new nor complicated, and the effects to be anticipated from its employment are definite and predictable. The agents most used and commonly available are heat, exercise, massage, radiation, electrotherapy in selected cases and passive movement. The field encompasses numerous other so-called modalities, but these need not be considered in detail here.

More important than the physical agents mentioned are the persons who bring them to the patient: the physical therapy technician and her co-worker, the occupational therapy technician. As in every other branch of medicine, the technic of procedures determines the safety of their application and their effectiveness. This is particularly true when physical therapy is applied in the treatment of trauma. The progressive pathologic changes which follow soft tissue injury present definite indications for physical therapy. The edema, swelling, pain, early muscle spasm and impaired function, present with both minor and major injuries to soft tissues, respond well to early physical therapy.[1]

The use of analgesics and early joint activity in the treatment of muscular strains and sprains has marked a definite improvement in therapy.[2] Consistent application of heat increases absorption of hematomas once the active hemorrhage has ceased. Antigravity measures and such other physical measures as gentle stroking massage and heat decrease swelling and edema. The early removal of edema in traumatic injury is essential for the preservation and restoration of good function. When the fact that 80 per cent of the injuries of World War I[3] were of the extremities is considered, the potent position of physical therapy in rehabilitation is readily appreciated.

Fractures occurred in 65 per cent of the injuries of World War I.[4] That physical therapy has a place in fracture treatment all authorities agree. Likewise, the untimely or improper use of physical therapy in a fracture case can be detrimental to healing and to the functional end result. Physical therapy in fracture cases should be started early.[5] Often local application

* Read before the Twenty-Third Annual Session of the American Congress of Physical Medicine, Cleveland, Sept. 6, 1944.

1. Darrach, William: Massage and Movements in Treatment of Fractures, J. Iowa M. Soc. 15:582 (Nov.) 1925.
2. Kraus, Hans: Use of Surface Anesthesia in Treatment of Painful Motion, J. A. M. A. 116:2582 (June 7) 1941.
3. Kennedy, R. H.: Panel Discussion; Treatment of Fractures, Bull. Am. Coll. Surgeons 27:117 (April) 1942.
4. Walters, Waltman, Care of Injured in War Zones, Bull. Am. Coll. Surgeons 28:115 (June) 1943.
5. Murray, Clay Ray: Immediate and Early Physical Therapy in Fracture Management, Arch. Phys. Therapy 19:74 (Feb.) 1938.

of heat or cold before a dislocation or fracture is prepared for reduction is good therapy. The presence of a fracture, except for the possibility of disturbing the fragments, does not contraindicate the use of physical therapy[6] within the limits already mentioned.

Tissues not immediately involved in the fracture per se must receive attention if best functional results are to be anticipated. Muscular atrophy in unused muscles should be counteracted by the use of electrical stimulation, deep massage and systematic exercise.

In tendon and nerve injuries, absolute coordination between surgery and physical therapy is essential. Tendon sutures require absolute rest in a position of relaxation until the area of repair has passed through the gelatinous stage to the period of its replacement by fibrous tissue at two to two and a half weeks. After this period, active movements should be started and splinting continued. Active movements at this time will prevent the fixation of the sutured tendon to surrounding structures by fibrous condensation, which proceeds rapidly at this point. After four weeks, active movements are further continued, with avoidance of any sudden jerking of the repaired tendon.

Nerve repairs require the same guarded postoperative treatment. Early protective splinting in relaxed position, care of the muscles involved to limit atrophy and early mobility to prevent the repaired nerve from being caught in scar tissue constitute good conservative treatment.

The presence of partial or complete severance of nerves may be determined by repeated electrical tests prior to operation. Such tests will determine the need and site of operation if surgical repair is to be attempted.

Casualties in this war include many cases of severe and extensive burns. Early physical therapy will do much to prevent adhesions and serious contractures. In late cases, when plastic operation has to be done, the surgeon has much need for physical and occupational therapy to increase the flexibility of tissues and prevent deformity.

The responsibility for the application of physical therapy in reconstruction rests primarily with the surgeon in charge of the case. His breadth of vision will decide whether physical therapy is to be employed, when and to what extent.[3]

Therapy, regardless of type, is prescribed as definitely as possible. Drugs are not ordered by name only. They are ordered in definite dosage with some therapeutic effect in anticipation. The same rules must govern the ordering of physical therapy. Good physical therapy depends on attention to detail in carrying out a prescription.[7] If the surgeon does not interest himself in this detail, he must not expect much in the way of results. If he is not acquainted with such detail, he should seek counsel. Most large hospitals today have physical therapy departments supervised by physicians trained in physical medicine and manned by registered physical therapy technicians. The Army and Navy have good physical and occupational therapy facilities even in some of their rather advanced bases.[8]

The matters mentioned are fundamental to the success of physical therapy when it is included in any rehabilitation plan. I should now like to discuss briefly the modalities mentioned earlier and perhaps clarify their use and indications.

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6. Murray, Clay Ray: Proper Place of Physical Therapy in Treatment of Fractures, J. A. M. A. 97:335 (July) 1931. Foster, George V.: Influence of Internal Fixation and Early Motion of Fractured Limbs, Arch. Phys. Therapy 33:609 (Oct.) 1942.
7. Hibben, John S.: Physical Medicine, J. A. M. A. 118:1038 (March 28) 1942.
8. Krusen, Frank H.: The Place of Physical Therapy in the Defense Program, Arch. Phys. Therapy 23:453 (Aug.) 1942.

Heat

Heat may be brought to a patient in many forms, and confusion often exists as to which form to choose under definite circumstances. Therapeutically, heat is either conducted to the surface of the patient's body or is generated at some selected site within his body. Any hot object, such as a hot water bottle, an electric pad or hot water in hot fomentations and hot soaks, produces conductive heat. Such heat does not penetrate beneath the skin surface. A warming of the tissue at the local site of application occurs, with vasodilitation and active hyperemia. The maximum temperature possible will be the maximum sensory tolerance of the patient. The hyperemia tends to rapid dissipation of the heat by normal physiologic processes of heat transfer in the body. To remain effective, contact of the applied hot body must be continuous at the site of application. The source of the heat gives off heat constantly, and if it cools it must be reheated. Owing to the increased rate of blood flow in the skin area under treatment, the heat is local and superficial except as the heated blood carries the heat deeper. Insulation against heat loss may produce a gradual deeper and more diffuse heating and result in a gentle rise in body temperature. If the conductive heat is applied to the entire surface of the body and insulation is complete, hyperthermia will result.

The only such method of conductive heat I would call special attention to is the whirlpool bath. This combines hydromassage through agitation of the water with hot water immersion per se. By this method, the entire volume of an extremity is considerably increased owing to the reflex sensory irritation of the agitated hot water and the heat itself, which gives the greatest vasodilitation of all the conductive heating methods. This increase in volume may be desirable or undesirable, according to the pathologic condition and the treatment that is to follow. Should exercise to increase function be desired immediately after a whirlpool bath, the engorgement of the part would not increase its effectiveness. In this circumstance a whirlpool bath should be given at a lower temperature than tolerance, say at 102 F. I would likewise mention the fact that by their very nature whirlpool baths must be given with the limb dependent. These considerations are very real and may influence prescription writing. One might like a whirlpool bath to be followed by a period of elevation of the extremities to offset any deleterious effects of venous engorgement.

Moist applications of heat are physiologically very effective. Conductivity of the skin to moist heat is greatest. Such applications are sensorially often less irritative and more acceptable to the patient.

Contrast baths should be mentioned here, as they stimulate active vascular exercise with marked hyperemic effects and a toning up of tissue.

Heat at greater than skin depth is produced by generating heat at a desired location deeper in the tissues of the patient. Such heat is termed conversive heat. The result is attained through conversion of energy of some kind to heat at the given site. The application may be a radiant source, such as a therapeutic lamp or a high frequency or radio frequency current. When rays from a luminous radiator encounter an opaque or semiopaque medium, certain rays are absorbed. The rays from such a source are a mixture of rays of different wavelengths and consequently different pentrability. Actually the penetration of luminous rays is directly as the intensity of their illumination; i. e., the brighter the luminosity of the source, the greater the penetration, and, contrariwise, the less the brilliance, the less the penetration.

This will simplify the understanding of the difference between so-called

commercial "infra-red" lamps and the brighter radiant heat lamps utilizing tungsten bulbs. Practically all of the radiation from the "infra-red" is absorbed in the skin. The skin gets very hot, stingy, counterirritated, and intensely hyperemic. The treatment is as effective in the skin as any form of heat would be, but has no effect beneath the skin. However, it is a good sensory pain reliever through the counterirritation produced. If the heat is to be effective to muscles or superficial joint areas, then the more luminous lamps must be used. With such lamps, the amount of heat is limited by tolerance of the skin, and the volume of heat is dependent on wattage of the lamp and the distance from the patient.

Heating by diathermy and short wave applications is at a depth and can be localized by careful technic. Diathermy is a more definite application, and can probably be better controlled and localized than can short wave heating. The latter has mechanical advantages in ease of its various applications. It likewise has certain freaky possibilities for danger which must be appreciated. The differences are academic, and the two forms can be used interchangeably in most conditions.

Ultrashort wave applications have increased heating possibilities with less skin effects, and in certain areas may be desired. The technic of ultrashort wave treatment, with 6 meter to decimeter waves, is likewise more critical than that of short wave therapy.

With this knowledge of heat to start with, the physician selects the modality and the technic to be used, precisely as the pathologic indications dictate.

Therapeutic Exercise

Therapeutic exercise is the backbone of orthopedic and traumatic physical therapy.[9] It is a large field. Technic is of the utmost importance. A thorough practical knowledge of anatomy and kinesiology is essential in directing exercise therapy. Technicians must be teachers if success is to accompany their efforts. They must also know the nature of the pathologic condition in the patient being treated, in order to know the purpose for which the exercises are given. The extent and limitations of the exercises and the progression of these exercises differ, as do the purposes for which they are given. They may be prescribed:

1. To enhance tissue drainage and improve circulation.[10]
2. To improve range of joint function.[11] (*a*) By relaxation of muscle spasm or, (*b*) By stretching of tissues or freeing adhesions.
3. To increase motor power.
4. To preserve function and preclude atrophy.
5. To improve coordination.

All these indications carry with them certain implications as to technic.[12] Exercises for improvement of muscle power imply, for example, basic evaluation of muscle strength and the giving of exercises graduated to that strength at the start, with a slow progressive increase in effort later on. The stages of this effort might be:

(*a*) Assistive exercises at first; the assistance may be accomplished manually, by use of pulley contraptions or with gravity assistance, with or without the use of inclined planes and arrangements for minimizing friction, or through utilizing the buoyant power of water.

(*b*) Free exercises against gravity.

(c) Resistive exercises.

9. Piersol, George Morris: Physical Therapy, J. A. M. A. 117:1837 (Nov. 29) 1941.
10. Neuwirth, A. A.: Non-Splinting Treatment of Fractures of the Elbow Joint, J. A. M. A. 118: 971 (March 21) 1942.
11. Kraus, Hans: Muscle Rehabilitation by Active Motion, Arch. Phys. Therapy 24:151 (March) 1943.
12. Snow, William B., and Gurewitsch, A. David: Muscle Reeducation in Therapy, Arch. Phys. Therapy 23:69 (Feb.) 1942

If the muscle is to develop strength, it must do a progressive amount of work. One might go on to exercise methods for increasing range of function at a joint. These might include the use of surface anesthesia coupled with active exercise in order to overcome the vicious pain-spasm cycle.[13] I am not speaking of passive exercises in this dissertation on exercise. I am considering only exercises performed by the patient himself. With regard to this unique utilization of surface anesthesia, a word regarding analgesia seems pertinent. Many physicians are a bit delinquent in not prescribing enough anodyne to control pain when relaxation of spasm will determine the possibility of improvement of function. An anodyne is often administered to diminish the pain, and no follow-up to improve function is made; this is a mistake.

The use of therapeutic exercise in the management of central and peripheral nerve injuries, orthopedic conditions and cases involving traumatic and plastic surgery needs no further elaboration here.

Whatever the exercise indications, special technics must be adapted to each case. If the result of exercise therapy is to be satisfactory, the technician must be trained to recognize malfunction of muscles, improper balance and the presence of substitution and must know how much or how little the pathologic condition and the patient will tolerate without excessive fatigue or other harm.

I must not pass over therapeutic exercises without calling attention to occupational therapy. Occupational therapy represents a specialized form of exercise therapy, something between calisthenics, fundamental exercise and work therapy. For improvement of function (not diversion in functional psychoneuroses or tuberculosis) there is probably no better form of exercise to show results than can be achieved by well thought out occupational therapy.[14] Occupational therapy implies a thorough knowledge of kinesiology and has much to offer for specific problems when lost function is to be restored. It also holds an advantage in that it can be made much more interesting than simple, more monotonous, less purposeful exercise routines.

Occupational therapy today leads on to work therapy. This is well demonstrated in such institutions as the Institute for the Crippled and Disabled in New York City,[15] and it is seen at its best in the relatively few "curative workshops"[16] which have been set up here and there about the country.

Occupational therapy must be made to fit the patient and must not tend to emasculate him mentally.[17] Knitting may be good for improving finger function, but sanding, setting press type or operating a power saw is a more satisfactory means of improving finger function in a red-blooded male patient.

Before passing on to massage, I would mention passive exercise. This form of physical therapy is the most potent for danger. Technicians are taught to fear it, how to apply it properly and also when to let the physician do it himself. A certain amount of passive stretching enters into legitimate physical therapy. Forced movement with pain in acute inflammation should never be done. Those who treat trauma know the poor results in fractures,

13. Snow, William B., and Kraus, Hans: Novocaine Iontophoresis for Painful Limitation of Motion, Mil. Surgeon 95:360 (Nov.) 1944.
14. Krusen, Frank H.: The Relationship of Physical Therapy and Occupational Therapy, Occup. Therapy 13:69 (April) 1934.
15. Deaver, George C., and Brown, Mary E.: Making Manpower, Arch. Phys. Therapy 23:719 (Dec.) 1942.
16. Coulter, John S.: Physical and Occupational Therapy in Rehabilitation, J. A. M. A. 121:866 (May 13) 1943. Garceau, George J.; McNary, Henrietta, and Anderson, Charlotte: Panel Discussion. Correlation of Physical Therapy and Occupational Therapy, Occup. Therapy 18:195 (June) 1939.
17. Licht, Sidney, and Reilly, Mary: The Correlation of Physical Therapy and Occupational Therapy, Occup. Therapy 22:171 (Aug.) 1943.

tendon repairs, bursal conditions and the like which result from too great zeal in passive movement.

Massage

Massage is not rubbing. An expert at massage takes years to attain his skill. Some people never can learn to do massage, as they never can develop the touch necessary for its skilful application. Massage, like heat, can produce diverse effects. The purpose for which it is being given must be known before a single stroke is applied.

Massage may be light or heavy, may be given for sedation or stimulation, may be used to increase blood flow to a part or to remove edema or swelling from a part; or may be used to assist relaxation and relieve pain. Definite contraindications exist against its use.

Certainly no one should order massage who has not a definite purpose in ordering it, who has not seen it done. Really to appreciate it, he should have at some time had a massage himself.

To mention a few indications:

1. Rhythmic stroking massage increasing in force in the treatment of low back pain will greatly relieve the spasm and improve the local circulation.
2. Heavy massage, actually trauma on trauma, will definitely cure a myositis.
3. Directional massage, stroking from the periphery toward the proximal part of an extremity, will reduce swelling and edema in patients with engorged circulation.
4. Gentle stroking, termed "effleurage," is the only type of massage indicated in cases of fracture before the swelling is completely reduced.
5. Pinching and moderately deep massage in subcutaneous fibrositis represents a highly specialized technic for a special purpose, as do certain technics of nerve massage.

Other Modalities

Other modalities used in rehabilitation are faradic stimulation of muscles where muscle function is impaired but no impairment in physiologic continuity of the reflex arc exists; use of sinusoidal currents for exercising muscles; use of static electricity which is capable of producing violent, painless, slowly oscillating contractions with marked decongestive effects; ultraviolet irradiation for its chemical effects on the blood on the phosphorus and calcium metabolism, the red cell count, the hemoglobin content and the vitamin D production and for its specific bactericidal effects in the treatment of many skin conditions and as prophylaxis against infection; use of the pressure vacuum boot in draining tissues and stimulating vascular exercise; exercises and electrical tests in determining malingerings, and physical therapy in the treatment of conversion hysterias.

Physical Therapy in Convalescence

I have covered rather specifically physical therapy in rehabilitation. There is one more pertinent indication for physical therapy which is being appreciated more definitely every day, namely convalescence. The aims during convalescence are recovery of physical strength, rejuvenation of the patient's spirit and the minimizing of any tendency to lasting disability after illness or injury. Physical therapy, occupational therapy, work therapy and recreation represent four adjuncts of medical and surgical practice which have much to contribute toward the desired end result.[18]

The needs for manpower in the armed forces and in industry have concentrated efforts toward the speeding up of convalescence. The physical fitness programs in the Army, the convalescent programs in the Army Air Force and the growth of industrial workshops and community centers for physical and occupational therapy reflect the importance of cooperative man-

18. Snow, William B.: The Employment of Physical and Occupational Therapy in Convalescence In publication.

agement in convalescence. The careful, definite application of physical therapy to alter some existing pathologic condition, to improve impaired function, to retrain and strengthen weakened musculature or to supplement some surgical procedure will materially lessen the period of convalescence. The ambulation of patients after bed rest should receive individual consideration. Loss of muscle tone, atrophy of muscles with attendant weakness, lack of support to circulation, circulatory readjustments and lowered morale are elements present in any patient regardless of the reason for his being put to bed. All such patients require slow, measured ambulation, with rapid increase in activity when they are equal to it.

The disability of such patients does not stop when they are put on their feet. The discharge note in the hospital chart should outline the convalescent care, and the patient should be impressed with the importance of carrying through the prescribed routine. If physical therapy and occupational therapy were indicated up to the moment of discharge, they should not be discontinued when the patient is discharged. Arrangements for the continuation of necessary treatment at home, hospital or dispensary should be made at the time of discharge, and routine follow-up should be carried out.

It has been considered good practice to avoid prolonged inactivity in the case of the aged patient who is acutely ill. Judicious early activity in such cases prevents atrophy, loss of strength and circulatory complications. Such practice should not be limited to the field of geriatrics.

Technicians

At this point I should like to say a few words concerning those who carry out the physician's orders in physical therapy—the technicians. These technicians represent one of the more highly skilled groups of medical co-workers. An acceptable physical therapy technician today is, first, an educated person with at least two years of preprofessional training. Often she is a graduate nurse. She not only must have judgment based on a thorough, highly specialized training in the use of modalities, but must know considerable about the progressive pathologic changes of the condition she is treating. In addition to this basic knowledge as a medical co-worker, she must be ethical and have tact and a proper psychologic makeup. Results in physical therapy will be sacrificed if nurses, secretaries, glorified maids or other untrained personnel are turned loose on patients, as has been common practice in the past. The technician likewise requires supervision. No medical technician can stand by herself. She is prepared to carry out special service, but she also is taught that she should not prescribe for her patient. This is the physician's responsibility in the case.

Conclusion

1. Physical, occupational and work therapy can contribute greatly to the functional end result of rehabilitation.
2. The indications for these types of therapy are well defined.
3. It is the function of the surgeon to see that physical therapy is admitted at that point in the rehabiliaion program where it can contribute most.
4. Orders for physical therapy should be written with care and specificity.
5. The technical detail of applying physical therapy should be entrusted only to properly trained personnel.

180 Fort Washington Avenue.

PHYSICAL MEDICINE IN THE REHABILITATION OF THE VETERAN OF THE WORLD WAR II*

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HINES, ILL.

In the newspapers and magazines, articles dealing with the rehabilitation of veterans of World War II frequently appear. On the radio there are panel discussions on the rehabilitation of these young veterans. Cities and states are discussing the problem. Numerous plans for rehabilitation have been set forth and many are now in effect. Most of these plans are concerned with the vocational rehabilitation of the veteran after his discharge from military service. In order to benefit from one of these plans or to carry out his own ideas for a postwar future, the veteran must first of all be rehabilitated physically or mentally, or perhaps both. When abnormal mental attitudes are based on physical disabilities it can be expected that physical rehabilitation will in turn produce mental rehabilitation. When this sequence of events has transpired, the veteran is ready for one of the programs for vocational rehabilitation.

In the Veterans Administration we are prepared to give the veteran of World War II the opportunity for complete rehabilitation. The veteran who has physical or mental disabilities incurred in or aggravated by military service is entitled to many benefits because of this service-connected disability. If he becomes ill, he may go to any Veterans Administration facility, where he will receive any medical, roentgen ray or laboratory examinations needed to determine the nature of his illness. He may be hospitalized for treatment if that is advisable. He is entitled to outpatient treatment, including dental care, for any physical disability which is service connected. Eyeglasses, dentures and other prosthetic appliances are available to him. Each veteran who is rated as having a service-connected disability of 10 per cent or more receives financial compensation commensurate with the degree of disability. If a vocational handicap exists, he (or she) may be given competent guidance to a vocation in which he may receive up to four years of specialized training or education.

The veteran of World War II who does not have a service-connected disability is entitled to all of the benefits of hospitalization. Domiciliary care may be provided for any veteran when it becomes necessary. When a veteran is rated as totally and permanently disabled he draws a pension of $50 per month if his disability is not service connected. If the permanent and total disability is service connected, the compensation is $115 per month.

Each Veterans Administration hospital has a physical medicine department with the necessary physical equipment to carry out its part of the rehabilitation program. In the Veterans Administration Facility at Hines, Ill., the physical medicine service is large, and in the physical therapy department alone about 6,000 treatments are given each month. We are now

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* Published with permission of the Medical Director, Veterans Administration, who assumes no responsibility for the opinions expressed or the conclusions drawn by the author.

preparing to install additional equipment and apparatus which will enable us to treat a larger number of patients more effectively. It should also aid us in reducing the periods of hospitalization. In planning our program of treatment, we must keep in mind the fact that the veterans of World War II will require much more attention from the department of physical medicine than will the veterans of World War I. The main reason for this is the large number of surgical, neurosurgical, orthopedic and other traumatic conditions which will occur in the younger men, who are actively engaging in military service. Although the personnel of the department of physical medicine is somewhat limited at present, it is anticipated that the availability of technicians will increase with the corresponding increase in the hospital admission rate of veterans of World War II.

The work of the physical therapy department at Hines is carried out in rooms set apart for the most common forms of physical therapy. We have one large well lighted room where all electrotherapy apparatus is located and where this form of treatment is carried out. Diagnostic procedures, such as the determination of the reaction of degeneration, are also performed here. The thermal therapy room contains infra-red and luminous heaters, and here the veteran receives radiant heat, massage and exercise. In the actinotherapy room there are two quartz mercury air-cooled burners over each table, so that the patient may receive ultraviolet radiation to his full body length when such treatment has been prescribed. The hydrotherapy room contains the equipment usually found in departments of physical therapy, and there is sufficient space for additional equipment. One room is set apart for the treatment of women patients, but they may also receive treatment in the other rooms at specified times. Some of our physical therapy equipment is located in the wards of the hospital or is taken to these wards daily by the technicians. One of the technicians is assigned to the orthopedic ward, where he is kept busy applying and supervising leg and arm bakers, ultraviolet irradiation and the pavex suction-pressure apparatus. He also gives massage and corrective exercises. In addition, he is prepared to give instruction in the use of artificial limbs according to the walking reeducation method outlined by Karsten and Sully.

One of the technicians is assigned to duty in the other wards of the hospital to give physical therapy to bed patients. Much of his work is with those measures which promote the circulation to the skin, lower extremities and other parts of the body. He also gives assistance and instruction to those physically weak patients who are attempting to become ambulatory again.

The services of the technicians in these various parts of the physical therapy department are rotated, so that each month a technician is in a different location, giving treatment to a different group of patients. This rotation of service stimulates the interest of the technicians and gives them an opportunity of administering the various forms of physical therapy.

The occupational therapy department at Hines is also large and is located close to the physical therapy department. The schedule of the patient can be so arranged that he may go from the physical therapy department, direct to the occupational therapy department, where he can continue with active exercise. In the occupational therapy department there are various rooms where metal working, woodworking, jewelry making, weaving of textiles, basketry and leather work are carried on. Here, however, the therapy aides are not rotated, since each one is usually better able to instruct in one particular craft. Three of the aides are assigned to duty in the wards, where the bed-ridden patients may have

the benefit of this form of therapy. About 40 per cent of the occupational therapy work is done in the shops, and about 60 per cent is done at the bedside. During the poppy-making season in 1944 over 1,500,000 poppies were made by the patients in the hospital at Hines. During the fiscal year, 3,294 other articles were made by the veterans who took prescribed occupational therapy. To the chronically ill patient, and to those who suffer pain, the amount of stimulation to the morale which this form of therapy provides is certainly great. When active exercise is indicated, occupational therapy projects, which divert the attention of the patient away from his disability, may result in more rapid physical recovery than uninteresting exercise in physical therapy with the attention focused on the disability. Therefore, if these two types of therapy are coordinated, earlier discharge from the hospital may be anticipated by the patient who receives them.

The first veteran of World War II to be admitted to the facility at Hines was received Feb. 15, 1942, sixty-nine days after Pearl Harbor. Oddly enough, this first veteran was admitted for a condition which was wholly unrelated to his military service. He had a brain tumor, which was successfully removed by the neurosurgeon. During the remainder of 1942 and the first part of 1943, the number of World War II veterans received from month to month remained low, and these men constituted an insignificant percentage of the 9,772 patients admitted during the calendar year of 1942. Beginning with the month of April, 1943, there was a marked increase in the number of patients admitted. By the end of 1943, about 200 veterans of World War II were being admitted to the hospital each month. Therefore, the percentage of veterans of World War II admitted has increased to a significant figure. Since the peak in the admission rate of veterans of World War I has not yet been reached, it is evident that an extra burden will be placed on the facilities of the Veterans Administration from year to year. The extra work will be reflected in the department of physical medicine.

During a thirteen month period, from July 1, 1943 to July 31, 1944, 2,307 World War II veterans were admitted to the hospital at Hines. During the same period, 150 World War II veterans were given regular treatment in the physical therapy department. There has also been a marked increase in the number of World War II veterans receiving treatment as outpatients. As stated previously, patients who receive physical therapy on an outpatient basis receive treatment only for a service-connected condition. In March, 1944, only one World War II veteran was receiving treatment on that basis. In July, 1944, 14 such veterans were receiving outpatient physical therapy. During the same month, over twice as many veterans of World War II as of World War I were receiving this therapy. Therefore, the veterans receiving physical therapy on an outpatient basis can be expected to increase at a rapid rate.

Among World War II veterans, arthritis is the most common condition being treated in the physical therapy department. About 45 of the group of 150 patients who received physical therapy were treated for this condition. Practically all of the joints of the body were represented. As would be expected, the joints of the extremities were the ones most commonly involved. The sacroiliac joints and the joints of the spine, involved with about equal frequency, were in second place. The shoulder joints were next. There was only 1 case each of arthritis of the hip and of the neck. Of the cases of arthritis, only 2 were regarded as acute. Hydrotherapy, in the form of the whirlpool bath, was the heat treatment most commonly employed in cases of chronic arthritis of the joints of the extremities. Short wave

diathermy alternated with infra-red heat was most commonly prescribed for the sacroiliac and lumbosacral joints and for the joints of the spine. However, infra-red heat combined with massage and exercise was the treatment prescribed in some of these cases. In a case of polyarthritis, the body whirlpool was used and was followed by a needle shower. In a case of rheumatoid arthritis, short periods of fever therapy were given. The form of treatment used depended on several factors, including the stage of the arthritis, the joints affected, the availability of the form of treatment prescribed and the choice of the ward physician who prescribed the treatment. In each case the treatment was prescribed or approved by the physician in charge of physical therapy.

General surgical and orthopedic cases were well represented among the 150 World War II veterans receiving physical therapy during the thirteen month period. There were 4 cases of cellulitis of the foot or leg and 2 cases of diabetic gangrene of the feet in which radiant heat was used several hours each day. There were 2 cases of osteomyelitis. One was of osteomyelitis of the tibia, and in the other the femur was involved. There were 4 cases of knee injury and 1 case each of strain of the lumbosacral and sacroiliac joint. In 4 cases of tuberculous spondylitis treatment was given in the form of massage and exercise to the lower extremities. In 3 cases of subdeltoid bursitis diathermy according to the technic advocated by Dr. Frank Krusen was successful. There were 6 cases of disturbance of circulation in the extremities, 5 of phlebitis or thrombophlebitis and 1 of Buerger's disease. There were 4 cases of fracture of the bones in the lower extremities, 2 cases in which the upper extremities were involved and 2 cases in which there was a fracture of the pelvis. It is interesting to note that in 1 of these cases a stray 20 mm. shell entered the patient's epigastric region and lodged securely against the acetabulum on the right side, causing fracture of the pelvic bones in that area. The shell was removed surgically with much difficulty, and osteomyelitis later developed in this area. There was only 1 case of amputation in this group of 150 cases, and that was a case in which several fingers had been amputated after they had been frozen while the veteran was in military service in Alaska.

Cases involving neurologic and neurosurgical conditions constitute another large group in which physical therapy was administered. In this major group, neuritis and hemiplegia were the conditions most commonly encountered. There were 8 cases of sciatic neuritis, in 1 of which the condition was bilateral. Short wave diathermy was the treatment of choice in most of our cases and was frequently alternated with infra-red irradiation. In some cases ionization with histamine was used. The body whirlpool bath was used in the case of bilateral sciatic neuritis. There were 4 cases of brachial neuritis, and short wave diathermy was used in these effectively. One case of trigeminal neuralgia was referred for infra-red heat followed by use of the rapid sinusoidal current. This form of treatment did not relieve the condition. Seven cases of hemiplegia were referred for treatment by the neurologic service. In 3 of these the hemiplegia was due to cerebral thrombosis. There was 1 case of cerebral embolism; the patient was an army chaplain in whom heart disease had developed. In 3 of the cases the hemiplegia was traumatic in origin: in 1 it was due to a penetrating shrapnel wound of the brain and in the other 2 it was due to brain concussion following a bomb blast.

Of the 150 cases being considered, in 7 there were spinal cord injuries. One man fell from a loaded truck, and another was injured when the truck in front of his was struck by a bomb, causing his truck to overturn. An-

other man was in a truck which slipped over the edge of a shell hole and overturned. One man was working on an airplane which toppled over on him. A fall down steps, a car wreck and a spinal epidural abscess following a spinal puncture accounted for the other 3 cases. Other cases of neurologic conditions included 3 of common peroneal nerve paralysis and 1 of complete paralysis of the right arm due to a wound of the right brachial plexus.

The skin conditions usually referred for physical therapy by the dermatologist were psoriasis and pityriasis rosea. In the treatment of these two conditions the use of ultraviolet radiation has proved to be effective. Another common skin condition that required the aid of physical therapy was decubitus ulcer. This was seen most commonly in veterans who had suffered injury to the spinal cord with resulting paralysis of the lower part of the body. The healing of this lesion depends primarily on continuous cleanliness of the part through proper nursing care, reduction of pressure to a minimum, with daily ultraviolet irradiation and long periods of exposure to infra-red radiation. One case of blastomycosis of the skin was treated successfully by the use of copper ion transfer. Other lesions on this patient had been treated by surgical excision and superficial roentgen ray therapy. These methods were also successful, but copper ion transfer is the method of choice because it leaves less skin destruction and the treatment period is no longer than that of the more dangerous roentgen ray therapy.

The eye, ear, nose and throat service made use of physical therapy to a much greater extent than one might expect. Sinusitis was treated with diathermy, and postoperative mastoidectomy wounds received infra-red radiation. Other conditions, such as arthritis and neuritis, occurring in the patients on that service were also referred for physical therapy.

This concludes a résumé of the work being done for the veteran of World War II in the physical medicine department in the United States Veterans Administration Facility, Hines, Ill. An indication has been presented of the types of veterans of World War II being received and of what is being done toward their rehabilitation. I wish to make it plain that the physical medicine departments of the Veterans Administration are to be depended on to do their part in the rehabilitation of these young men and women who come to us from the home front and from the battle fronts of the world.

Discussion

Lieut. Col. Charles R. Brooke (Washington, D. C.): The physical and mental rehabilitation of a veteran is the problem of the Veterans Administration and when this is accomplished, the veteran is then ready for a selected program for vocational rehabilitation which is likewise a problem of the Veterans Administration. The hospitals in the Veterans Administration are divided into three groups, general medical and surgical, psychiatric and tubercular; some are large combined facilities, that have outpatient departments under the same jurisdiction. In some localities, the outpatient activities are located in regional offices, some with departments of physical medicine set up for outpatient treatment and others are in the process of being established.

The departments of physical medicine in the Veterans Administration are equipped with recognized and approved physical modalities, sufficient to treat types of cases in the respective facilities. The size of the clinics and the equipment set up are in accordance to the bed capacity which ranges from 250 to 2,000 or more. In nearly all of the facilities the bed capacity has recently been increased with authorized emergency beds over the standard capacity.

Steadily increasing numbers of veterans of World War II are being admitted for treatment of disabilities to hospitals of the Veterans Administration. Because of the character of the injuries and the diseases a large percentage of these veterans are being referred at some time during the period of hospitalization to the department of physical medicine for treatment. In this connection, the outpatient load in the combined facilities and the regional offices have been greatly increased by the veterans of World War II. Because of the steady increase of inpatients

and outpatients of World War II, the activities of the department of physical medicine will have necessary additional equipment and trained physical therapists properly to take care of the extra work.

The treatment in the department of physical medicine of the group of 150 veterans of World War II out of a total admission of 2,307 veterans of World War II represents a low percentage but this number will probably be increased before final discharge from the hospital. The records show that of the total number of patients hospitalized the percentage of those who receive physical treatment is approximately 20 per cent, general medical and surgical; 19 per cent, tubercular and 14 per cent, neuropsychiatric.

The physical treatment outlined for the group of 45 arthritic patients, veterans of World War II, clearly shows how much can be done in the way of physical rehabilitation for the crippled arthritic patient.

The general surgical and orthopedic cases represented among the group of 150 veterans of World War II receiving physical therapy comprise a variety of conditions in which the application of physical medicine is an indispensable adjunct and the results obtained are conclusive of its value in our program of physical rehabilitation of veterans.

The treatment of the neurologic and neurosurgical conditions referred to, occurring in veterans of World War II is an excellent indication of the value of physical therapy in conjunction with other recognized procedures. This is true particularly for the 7 patients with hemiplegia and the 7 patients with injuries of the spinal cord.

The effectiveness of the use of physical medicine is further demonstrated in the report of selected cases referred from the dermatologic and eye, ear, nose and throat services.

In conclusion the paper gives a good résumé of the work that is being done for the veteran of World War II in the department of physical medicine at the Hines Facility, which is one of the largest departments in the Veterans Administration and can serve as a pattern for the application of physical medicine in the medical program for rehabilitation in our other large general medical and surgical facilities. The author is to be commended for his treatment and the results achieved in the series of 150 patients, veterans of World War II in the department of physical medicine at the Hines Facility.

SPA THERAPY OF ARTHRITIS AND RHEUMATIC DISORDERS

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Arthritis and the various types of rheumatic disorders constitute one of the most common causes of disability of the adult population today. It has been estimated that there are more than six million persons in the United States afflicted with these disorders, which cause untold suffering and prolonged loss of time from work. This situation has become a challenge to the medical profession. Research and clinical studies have been directed toward discovery of the causation of the various types of rheumatism. So far no specific causative agent has been found, except for gonorrheal and tuberculous arthritis, through focal infection, fatigue, exposure, glandular and vitamin deficiencies, nervous and physical strain and metabolic disorders seem to have an important part in the development of the disease. Since no one causative agent has been found, the treatment has necessarily been based on broad principles of symptomatic therapy directed toward relief of pain, prevention of deformity and restoration of normal function. It is for this reason that spa therapy deserves careful evaluation in any plan of treatment.

In European countries it has long been the custom for patients to go to spas for the treatment of chronic diseases, such as arthritis and rheumatic disorders, but in the United States only a beginning has been made in the utilization of such facilities. The modern, well regulated spa has much more to offer the arthritic patient than "hot baths." There is a great deal of difference between "hot baths" and supervised hydrotherapy. Fortunately physical therapy is applicable to all forms of rheumatism, though the type of therapy used will naturally depend on the type of involvement.

Spa Therapy

While hydrotherapy is the main element of spa therapy for arthritis, many other forms of physical therapy are employed with beneficial results. The treatment may best be discussed under several headings.

1. *Application of Heat.* — Heat is one of the oldest types of physical therapy for arthritis. It may be applied by means of hot tub baths, hot fomentations, infra-red or sun lamps, diathermy, paraffin applications or mud baths. The routine treatment with hot baths is much the same at the different spas; therefore the routine employed at Hot Springs National Park will be briefly described as an illustration of this type of therapy.

The patient is placed in a tub filled with water at a temperature of 96 to 98 F., the temperature being gradually increased to 99 or even to 101 F. The time in the tub depends on the patient's condition, generally ranging from fifteen to thirty minutes. While the patient is in the tub a gentle friction rub is given by the bath attendant, who uses a rough bath mit. This is usually followed by a short period in a vapor cabinet, generally two to five minutes, to induce active perspiration, after which the patient is placed on a cot in the pack room, in which the temperature is maintained at 115 F. While he is there hot fomentations are applied to the affected joints; these are renewed two to three times in a period of fifteen to thirty minutes. A cold towel is applied to the head during that time. The patient then goes to a cooling room and is given a tepid needle shower followed by a longer period in a second cooling room. After the reaction of the bath has subsided and the patient is cooled, he is permitted to go to the dressing room. It is recommended that he wait one to two

hours after a meal before taking the bath. During the bath the hot mineral water is taken internally. Generally twenty-one baths are considered a course, one being taken each day if the patient's condition permits. Most arthritic patients take several courses of baths. Scotch douches, hot spinal sprays and salt glows may be added to the bath as prescribed by the physician.

The use of hot water in the treatment of arthritis goes back to ancient times. A definite physiologic reaction is produced by this application of heat. There is a pronounced increase in the circulation, manifested by an increase in the heart action and by an increased redness of the skin. The blood is brought from the deeper areas of the body and carried through the lungs to the dilated capillaries under the skin. This results in an improvement in the quality and quantity of blood brought to the affected areas, especially when the circulation is localized by the application of hot fomentations. There is an increase in the activity of the sweat glands and in the elimination of waste products through the skin, as well as through the kidneys, especially when the patient drinks the hot mineral waters while in the bath. The cellular metabolism increases, and the tissue immunity improves. Muscle spasm is relaxed, and there is relief from pain and discomfort in the joints. With this response to the application of moist heat it is easy to see why the arthritic patient is benefited by this procedure.

Dry heat may be utilized by means of infra-red or sun lamps, electric bakers or diathermy and is useful when the baths may not be taken. It is excellent as follow-up treatment after a course of baths at a spa. The procedures can be carried out by the patient in his own home, but definite directions should be given for their use, as they have certain limitations and must be properly employed to be beneficial.

2. *Exercise.* — Massage, exercise and under-water therapy have a beneficial action in rheumatic disorders and have been employed since early times. Massage when properly given is a useful procedure to improve local circulation, to prevent atrophy, to correct deformities and to restore muscle tone. It should be mild at the beginning and increased gradually according to the patient's strength and the reaction brought about. Active exercise is also desirable but is frequently overdone. The patient, because of his fear of becoming crippled and in consequence of the old idea of walking off the stiffness of a sore joint will overdo this form of therapy, thereby greatly increasing his suffering and adding to the damage already created by the arthritic process. At the spa the type and the duration of exercise are arranged by the patient's physician so that the exercise is kept within proper limits.

The use of the pool for underwater therapy of arthritis has proved a most valuable and satisfactory adjunct to the other types of exercise therapy. The buoyant action of the water permits a more effective application of exercise to atrophied muscle groups and enables the patient to use his weakened extremities more easily. The warm water relaxes the muscles and ligaments, allowing a greater range of motion with less effort and pain. In the pool traction can be easily employed to correct deformities, and passive motion and voluntary exercises can be carried out with less difficulty. The fact that the patient is able to help himself and can walk in the pool without aid has a valuable psychologic effect as well. The application of this form of therapy has been clearly presented by Smith and Cook.[1]

3. *Rest.* — While rest is one of the best therapeutic agents in the treatment of arthritis, this does not mean that continuous rest in bed is desirable. Joints should not be kept immobilized for long periods, as they may become stiff

1. Smith, E. M., and Cook, B. L.: Underwater Therapy at Spas, J. A. M. A. 124:505 (Feb. 19) 1944.

and ankylosed. Rest should be employed to ease fatigue and nervous exhaustion and to restore depleted vital energy. If the patient is left to himself, he is likely to overdo this type of therapy. Definite periods of rest are prescribed at the spa, either during the day or after baths, massage or other types of physical therapy. Rest has its greatest importance in the acute stages of arthritis.

4. *Other Features.* — Most spas are located away from industrial centers, so that the patient can have exercise in the open, enjoy the sunshine and have new and different surroundings. He is away from the worries and anxieties of home and business and is able to devote his entire time to the treatment of his ailment. He can have the supervision of an experienced physician, who is able to advise him in regard to the baths and other types of physical therapy best suited to his individual ailment, as well as to prescribe any necessary medication.

Results of Spa Therapy

Arthritis or rheumatism is not a simple disorder of the joints, but is a group of widely differing types of pathologic involvement classified together because of involvement of the joints and adjacent structures. It is not a disease of advanced age, as it is so often considered, but may occur at any age. Not all types are equally disabling, nor are all types equally amenable to treatment. The type of therapy employed at the spa will naturally differ considerably, depending on the type of arthritis.

It has been noted that the application of heat to the body is followed by a definite physiologic response, which is beneficial in the treatment of arthritis. The increased circulation, improved metabolism and increased elimination of waste products and toxins aid the body in its effort to heal the affected joints. Many patients are completely relieved, and in the large majority improvement is obtained. It is surprising at times to see the rapidity with which the patient improves, to note the reduction in the swelling of the joints and the decrease in the stiffness and soreness in the muscles and ligaments. The relief from pain is often striking. It is true that in the advanced stages, with low vitality, exhausted bodily resources and marked deformities, complete recovery cannot be expected. Some do not remain long enough to get the best results. One cannot expect joint changes of years' duration to clear up with a short course of baths. Several courses of baths may be necessary. Proper medical supervision, with removal of foci of infection, proper elimination, and the use of building foods, together with relief from business cares, contributes to the results obtained from spa therapy.

The results in the different types of arthritis and allied rheumatic disorders may best be considered by grouping the disorders according to a broad general classification, as follows:

1. *Atrophic or Rheumatoid Arthritis.* — This is a systemic disease characterized by an inflammation of articular and periarticular tissues, tending to be progressive, which may lead to atrophy, deformity and ankylosis and is commonly seen in young adults. It is probably the most common type of arthritis. The exact causation is not known, though a streptococcic infection is often considered the basic factor. Patients with this type of arthritis do well at the spa, though many wait until the disease is well advanced, with atrophy and contractures present, before coming for treatment. When the patient is seen early, the baths, rest and exercises are very beneficial. Under-water therapy has been especially valuable when deformities have occurred.

2. *Hypertrophic Arthritis or Osteoarthritis.* — This is a degenerative condition of the joints, characterized by an erosion of the cartilaginous surface of the joints, proliferation of the bony margins and limitation of motion, and is commonly seen after middle life. Patients with this type of arthritis make up the second largest group coming to the spa. While some of the changes seen in the joints are considered to be the result of aging of the joint structures, it is generally believed that wear and strain on joint surfaces poorly supplied with blood is one of the main factors. Since the blood supply to the joint cartilages becomes less after middle life, it is easy to see why strain and exposure would be more likely to result in joint damage. These patients do well at the spa. The hot baths and hot fomentations increase the flow of blood to the affected parts, producing an increase in motion, a decrease in swelling and greater comfort. While it is true that the baths do not change the bony deposits about the joints, the reduction of the swelling in the soft tissues about the joints gives much relief. Massage, a reducing diet and limited exercises are also valuable.

3. *Specific Infectious Arthritis.* — This type, in which a recognized specific infectious agent is found, comprises gonorrheal and tuberculous arthritis, and is represented by a small group of patients. Those with gonorrheal arthritis do well, responding nicely to the baths and treatments. Patients with tuberculous arthritis are not allowed to take the baths, rest, sunshine and proper diet being employed.

4. *Metabolic Arthritis.* — This classification includes mainly gouty arthritis, characterized by a disturbance of uric acid metabolism, and recurrent joint involvement. It is being recognized much more frequently now, and is being better managed. Spa therapy has always been beneficial, and the patients respond well to the treatment. Hot baths, hot packs, vapor baths and the drinking of the mineral waters, as well as regulation of the diet, do much to shorten the attack.

5. *Nonspecific Arthritis.* — This classification includes a miscellaneous group of joint disorders resulting from trauma, neoplasms and neuropathic disturbances. Patients with involvement following trauma are especially benefited. Neoplasms should be recognized early, and the patients should have proper orthopedic and surgical treatment, as the baths are contraindicated. Patients with joint disorders resulting from neuropathic disturbances, such as Charcot joint, improve with mild physical therapy along with proper medical management.

6. *Allied Rheumatic Disorders.* — This group is composed of fibrositis, often called muscular rheumatism, neuritis and neuralgia. These may be primary conditions, but are more often secondary to atrophic arthritis and osteoarthritis. At times the symptoms of these secondary and allied rheumatic disorders may be so severe as to overshadow completely the primary articular involvement, particularly that about the shoulder and in the lumbar region. All of these conditions are greatly benefited by spa therapy. Hot baths, hot fomentations, mild massage, passive exercise and under-water therapy are employed with good results.

Why Go to a Spa?

Since many of the procedures employed at the spa can be carried out at home, the question naturally arises, "Why go to a spa or health resort for treatment?" It is true that the arthritic patient can take hot baths at home, but the spa offers more than just "hot baths." It gives regulated hydrotherapy. It is the proper application of heat that produces the best results. At the spa the patient will have the supervision of persons ex-

perienced in giving hot baths and other physical therapy procedures, who can apply them to give the most effective and beneficial results. It is for this reason that results are obtained at the spa that cannot be duplicated at home.

When the patient goes to a spa he gets away from business cares and home problems, and is able to devote his entire time to the treatment of his arthritis. He is able to rest sufficiently after the various procedures so that the best results can be obtained. He goes with the idea of obtaining a cure and his enthusiasm is fostered by the stimulating surroundings in which he sees others similarly afflicted being benefited and realizes that he too can be helped. All this may be a psychologic action, but there is no doubt that the patient's mental attitude plays a decisive role in the results obtained with any plan of treatment.

At the spa the patient can get proper rest; he has time for complete relaxation, time to visit leisurely with his fellows, time to enjoy himself outdoors, and time to allow his body to build up a reserve of vital energy. Not only are rest and properly applied baths obtainable at the spa, but all types of physical therapy are available, to be employed as indicated by the patient's condition.

When the average American citizen goes to a health resort, he usually goes on his own decision, and wants to take the baths to his own satisfaction and as he pleases. This may work out well in some cases, but hydrotherapy taken under proper supervision is much more likely to result in improvement and increased benefits. At the spa the patient can find physicians who are experienced in the management of arthritis and rheumatic disorders, who will be able to supervise his treatments, employing the various types of physical therapy as indicated by his condition, arranging rest periods, suggesting proper diets and prescribing the necessary medication. As a general rule supervised treatments pay dividends.

There has been much controversy as to whether natural thermal and mineral waters are preferable to ordinary tap water in the hydrotherapeutic treatment of arthritis and other chronic diseases. While it is true that any water may be employed in the application of moist heat to the body, it is the carefully regulated and proper application of the hot water that brings the best results. The natural thermal and mineral waters give added benefits over ordinary tap water, especially when taken internally along with the baths. Many natural thermal waters are radioactive, for example the hot water at Hot Springs National Park, which constitutes an additional advantage in their therapeutic action.[2]

Where to Go

There are many spas and health resorts in the United States. According to the report of the Saratoga Springs Commission to the New York legislature in 1930, there are over two thousand areas where mineral springs are found. However, only a few have been developed for the treatment of patients; among these are Hot Springs National Park in Arkansas, Saratoga Springs in New York, Hot Springs in Virginia, French Lick in Indiana and Mount Clemens in Michigan. The patient should consult his physician, who after examining him will be able to advise him which spa will be most suitable. The average American and his physician have not been educated to the proper value of spa therapy. It is a new obligation for the physician to acquaint himself with the place of spa therapy so that he may be better able to advise his patients.

2. Scully, F. J.: The Role of Radio Activity of Natural Spring Waters as a Therapeutic Agent, J. Arkansas M. Soc. 30:206 (Mar.) 1934.

The Value of Spa Therapy

The value of spa therapy in the treatment of arthritis has been amply demonstrated in all health resorts where it has been properly employed. Increasing numbers of arthritic patients are coming to the spas to get relief. Since arthritis is by nature a chronic disorder, often requiring more than one course of treatment at the spa, many patients return year after year because of the improvement gained from each period of treatment.

It is evidence of the value of spa therapy that the United States Government is sending many of its soldiers in whom arthritis or other disorders have developed to spas for treatment. The Army and Navy General Hospital at Hot Springs National Park has been designated as the arthritis center for the United States Army.

The results obtained at spas have been striking enough to justify the continued development of these resources in the United States. Facilities should be provided so that physical therapy procedures can be efficiently carried out. It is the injudicious and unskilled use of these agents that has brought about much of their disrepute. Results have been obtained after patients have spent thousands of dollars in a search of the cause of their arthritis and practically nothing for worth while physical therapy.

Spa therapy is developing into one of the most effective means of benefiting the arthritic patient, in combating deformity, in increasing the use of the affected joints, and in improving his general health. Spa therapy is not a cure but a therapy that can be adapted to the needs of the individual patient. The results that have been obtained by this form of therapy should entitle it to greater recognition in the future.

CEILING RAISED FOR PHYSICAL THERAPISTS

The ceiling for Physical Therapists in the Medical Department of the Army has recently been increased. While a substantial number now in training will be eligible for commission at a later date, the present need for qualified personnel is of such urgency that every cooperation is being solicited for immediate recruitment of Physical Therapists to care for increasing numbers of sick and wounded. Qualified Physical Therapists are urged to contact the Office of The Surgeon General, Washington 25, D. C., Attention: Physical Therapy Branch; or the Officer Procurement Service which is located at each Service Command Headquarters.

Recruitment has been resumed for enlistment in the Women's Army Corps of women qualified to attend the Training Courses in Physical Therapy conducted by the Medical Department of the Army. Upon successful completion of these courses, enlisted women are commissioned as Physical Therapists in the Medical Department. These training courses are conducted at Army General Hospitals, and have been approved by the Council on Medical Education and Hospitals of the American Medical Association as conforming to the standards established by that body for approved Schools of Physical Therapy. Additional information regarding this program may be obtained from the WAC recruiting offices or by contacting the Office of The Surgeon General, Attention: Physical Therapy Branch.

ARCHIVES of PHYSICAL MEDICINE
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.·. EDITORIALS .·.

AN IMPORTANT ANNOUNCEMENT FROM THE NATIONAL FOUNDATION FOR INFANTILE PARALYSIS

The following is an official announcement of the National Foundation for Infantile Paralysis relative to the granting of a large fund for the training of physical therapy technicians, released for publication Monday, March 19, 1945.

"A critical shortage of qualified physical therapists which endangers the proper care of infantile paralysis victims has caused The National Foundation for Infantile Paralysis to appropriate $1,267,600 for the training of these vitally needed specialists, Basil O'Connor, president has announced.

"Present day medical treatment of patients with infantile paralysis demands more and more physical therapy Mr. O'Connor explained. 'A physical therapist is a technician who uses physical agents such as heat, electricity, light, exercise, rest, muscle training and similar methods in contrast to the use of drugs, biological and surgical technics.

" 'Today there are only 2,500 qualified physical therapists, of whom more than half are in the Armed Forces. With earlier and more extensive use of such methods of treatment, so imperative in the treatment of infantile paralysis, twice the number already trained could be used for this disease alone. It is estimated that an additional 5,000 could be used right now, not only for the treatment of infantile paralysis, but also for aiding recovery from many other diseases and disabilities.'

"The $1,267,600 program developed under the guidance of a special committee established in the field of physical therapy consists of three parts:

(1) $1,107,000 for scholarships to train new physical therapists.

(2) $82,000 for fellowships to provide additional teachers and

(3) $78,600 for general development of the field of physical therapy.

"The $82,000 allocated for teaching fellowships will provide additional teachers of physical therapy, and make possible a greatly expanded training program. At least 16 fellowships in teaching are available under this plan, each providing $2,000 plus tuition for one or two years, depending on the accepted candidate's educational background and program of study.

" 'We feel,' said Mr. O'Connor, 'that this step constitutes one of the outstanding contributions which the American public has made through the March of Dimes to the fight against infantile paralysis.

" 'The National Foundation since it was organized in 1938 has spent up to now more than a million dollars in the development of the fields of physical medicine and physical therapy.

" 'This new program is designed to provide urgently needed personnel necessary to fulfill the Nation Foundation's pledge that complete medical care will be assured, so far as possible, for infantile paralysis victims, regardless of age, race, creed, color or lack of financial ability to pay for services rendered.'

"Under the chairmanship of Dr. Irvin Abell, of Louisville, Kentucky, chairman of the Board of Regents of the American College of Surgeons, a special committee has been formed to assist in the development of the new program. In addition to Dr. Abell it includes: Dr. Donald B. Armstrong, of New York, second vice-president, Metropolitan Life Insurance Company; Dr. Max M. Peet, of Ann Arbor, Michigan, Chief, Neurosurgical Section, University Hospital and Professor of Surgery, University of Michigan Medical School; Dr. Morris Fishbein, of Chicago, Editor, *The Journal of the American Medical Association;* Dr. Arthur L. Watkins, of Boston, Director of the department of physical therapy, Massachusetts General Hospital; Dr. M. G. Westmoreland, of Chicago, staff, Council on Medical Education and Hospitals of the American Medical Association; Miss Jessie Stevenson, of New York, President of the American Physiotherapy Association; Miss Lucille Daniels, Acting Director, division of physical therapy, Stanford University; and three representatives of the National Foundation, Mr. O'Connor, Dr. Don W. Gudakunst, Medical Director, and Miss Catherine Worthingham, the National Foundation's Director of Technical Education.

"Preparation for entrance into approved schools of physical therapy requires graduation as a nurse, or physical education, or two years' college training including biology and other basic sciences.

"Scholarships for training in physical therapy under the $1,267,600 program of The National Foundation for Infantile Paralysis are available immediately for class commencing in June and July, Basil O'Connor, president of The National Foundation announced.

"As a result of the increasing use of physical therapy in the treatment of infantile paralysis and other diseases, and because of the acute shortage of trained personnel, the National Foundation is offering these scholarships for nine to twelve months' courses in approved schools of physical therapy. The scholarships will cover tuition and maintenance in accordance with the student's needs.

"Applications for scholarships should be made to The National Foundation for Infantile Paralysis, 120 Broadway, New York 5, N. Y., or to the American Physiotherapy Association, 1790 Broadway, New York 19, N. Y."

The announcement of the foregoing grant by the National Foundation for Infantile Paralysis is most gratifying. The grant at this time is very logical and timely since it closely supplements the grants by the Baruch Committee. The Baruch Committee is primarily endeavoring to train physisians in the field of physical medicine and to establish centers for furthering the study in the general field and for research centers. On the other hand, the National Foundation grants were allocated for at least three major purposes. These are (1) to establish means by which teachers in physical therapy technic may be more widely trained, (2) to allow better opportunity for those who wish special training or "brush-up" courses, (3) and most important of all to assist in the securing of an adequate number of trained technicians to meet the present demand at least partially.

The National Foundation has estimated the number of technicians needed. This number is undoubtedly conservative. However, this number will take time to secure and it will necessitate greater effort and interest on the

part of all institutions offering such training. The grant will assist in providing adequate numbers of trained personnel for both graduate and undergraduate training in this field.

The grants will do much to provide funds for procuring adequately trained teachers and students so that the present high standards of technical aides may be maintained. This aid by the National Foundation should do much to stimulate indirectly more physicians to become properly trained, to obtain advanced training in the field of physical medicine so that they may be capable of directing highly trained technical teaching staffs and to give proper guidance to highly trained technicians in their work. The necessity for advanced training in physical therapy technic for teachers and the necessity for granting of advance degrees should indirectly stimulate greater advancement and research in the general field of physical medicine. These grants of money for furtherance of the field, by the National Foundation for training of technicians and by the Baruch Committee for the training of physicians and the establishing of research centers, will be of inestimable value and offer great security to this comparatively young specialty. Advancement of the field of physical medicine cannot expect to keep pace with that of other fields of medicine unless it has properly trained technical personnel and unless sufficient research is done to clarify the many problems still unexplored. Neither can physical medicine expect to advance unless there is detailed supervision of those trained in physical therapy technic. On the other hand, physical medicine is directly dependent on highly trained technical aides. They must both progress together.

Patients who are afflicted with diseases or conditions which necessitate the use of physical agents in their treatment, physicians in physical medicine and technicians should and certainly will be most grateful to the National Foundation and the people supporting it for this most timely and substantial aid.

MEDICAL NEWS

New England Society of Physical Medicine

"The Physics of Short Wave Therapy" was the subject of the paper by Kurt S. Lion, Eng. D., assistant professor of applied biophysics, Massachusetts Institute of Technology, which was read at the meeting held March 21 in Boston of the New England Society of Physical Medicine. A meeting of the council and an informal dinner preceded the program.

Physical Medicine at Northwestern

The department of Physical Therapy at Northwestern University Medical School has been changed to the Department of Physical Medicine. Two promotions and a new appointment to the faculty have recently been made in this department. Dr. S. L. Osborne was promoted from assistant professor to associate professor, and Dr. C. O. Molander was promoted from associate to assistant professor. Dr. H. D. Bouman has been appointed assistant professor.

News from Editor Solomon

The central office has received word that our colleague and member of the ARCHIVES editorial staff, on leave of absence in the armed forces, has been promoted to the rank of Lieutenant Colonel. Col. Solomon is in the Pacific theater.

Captain Pruce New Director

Capt. Arthur M. Pruce has recently been appointed director of the school for physical therapy technicians at Lawson General Hospital, Atlanta, Georgia.

Physical Therapists Needed for Navy

Women are needed (age 20 to 49). Requirements are graduation from an approved school of physical therapy. The duties are teaching the various types of physical therapy to members of the Hospital Corps in naval hospitals and supervision of treatment given to patients who require physical therapy. Consult your nearest office of Naval Officer Procurement: Board of Trade Building, Chicago 4, Ill.; 617 Vine Street, Cincinnati 2, Ohio; 1249 Washington Boulevard, Detroit 26, Mich.; 1009 Baltimore Avenue, Kansas City 6, Mo., and 1645 Northwestern Bank Building, Minneapolis 2, Minn.

Information Bulletin on Rehabilitation and Reconditioning

The Baruch Committee on Physical Medicine is making available without charge a bulletin of information on "War and Postwar Rehabilitation and Reconditioning." The booklet, which may be obtained on request through the committee, 597 Madison Avenue, New York 22, contains up-to-date reports on the recent activities in reconditioning and physical rehabilitation from the Army Reconditioning Division, from the Rehabilitation Division of the Medical Department of the Navy, from the Convalescent Training Division of the Army Air Forces, from the Division of Physical Medicine and Medical Rehabilitation of the Veterans Administration, from the Committee on Convalescence and Rehabilitation of the National Research Council and from the Federal Security Agency concerning the Federal-State Program of Vocational Rehabilitation for the Civilian Disabled.

Colonel Ravdin Named to Barton Professorship

Col. Isidor S. Ravdin, M. C., who is in command of an army hospital in India while on leave of absence from the University of Pennsylvania School of Medicine, has recently been appointed John Rhea Barton professor of Surgery.

Report of Subcommittee on Surplus Medical and Hospital Supplies

The members of the committee on surplus medical and hospital supplies are Dr. Palmer, Chairman; Dr. Ernest E. Irons, Dr. Morris Fishbein, Rev. A. M. Schwitalla and Miss Mary Switzer. Since the last meeting of the Committee on Postwar Medical Service a Surplus Property Board has been appointed. The U. S. Public Health Service has drawn up a plan for the disposal of surplus medical supplies and Paul M. Stewart, who had prepared the plan, has sent copies of it to the various professional organizations interested. The subcommittee is to be continued with Father Schwitalla as Chairman in place of Dr. Palmer. Dr. George Morris Piersol was appointed a member of this subcommittee. The subcommittee was instructed to review the plan and to report back to the Joint Committee with recommendations to be presented to the American Medical Association.

Pamphlets Available

Announcement is made of the publication of the following valuable pamphlets:

"The School of Another Chance," summary of results, July 1, 1943 to June 30, 1944, and services offered, both obtainable by writing the Institute for the Crippled and Disabled, 400 First Avenue, New York 10, N. Y.

"Illinois Laws Relating to Handicapped Chil-

dren," second edition, Illinois Commission for Handicapped Children.

"The Illinois Plan for Special Education of Exceptional Children: The Educable Mentally Handicapped," Circular Series B, No. 12, issued by Vernon L. Nickell, Superintendent of Public Instruction.

The following pamphlets may be obtained upon request from the American Physiotherapy Association, 1790 Broadway, New York 19, N. Y.:

Physical Therapy: A Profession with a Future by Mary E. Nesbitt. *Infantile Paralysis Round Table* at the Twenty-Third Annual Conference of the American Physiotherapy Association, May 1944 (price 25c).

The Joint Orthopedic Nursing Advisory Service, 1790 Broadway 19, N. Y., is offering the pamphlet "Crutch Walking by Lois Olmsted, consultant in orthopedic nursing for the National League of Nursing Education. This article is reprinted from the *American Journal of Nursing*, Vol. 45, Number 1, January 1945.

The National Social Work Council has prepared, at the request of the National Committee on Service to Veterans, a booklet entitled *Service to Veterans* which is "a compilation of statements from twenty-one National Social Work Agencies concerning their programs for veterans."

Copies of the above booklet may be obtained at $1.25 each from the National Social Work Council, 1790 Broadway, New York 19, N. Y.

Proceedings of Conference on Rheumatic Fever, Washington, D. C., October 5 to 7, 1943, put out by the United States Department of Labor, Children's Bureau, Publication 308, price 20 cents, for sale by the Superintendent of Documents.

The United States Department of Labor has issued its thirty-second annual report for the fiscal year ended June 30, 1944.

The Children's Bureau of the Department of Labor has just published two pamphlets: "Facts About Crippled Children," 1944, publication 293 and "Proceedings of the Conference on Rheumatic Fever," Washington, D. C. Oct. 5 to 7, 1943, publication 308.

New Headquarters for National Council on Rehabilitation

As of March 1, 1945, the National Council on Rehabilitation will move to its new office at 1775 Broadway, Room 741-4, New York 19, N. Y. The Council would appreciate having all future correspondence addressed to 1775 Broadway.

Film on Reconditioning of Amputees Released for Public Showing

"Swinging into Step," a motion picture which shows how soldiers who have lost arms or legs are prepared by the Army Medical Department not only for their return to civilian life, but for their "come back," has been released for public showing. Originally produced as a restricted "training film," for showing to the men, themselves, as soon as possible after they are wounded, this inspiring picture is now available to clubs, schools and other organizations as well as commercial movie houses. Requests should be directed to the Public Relations Officer of the nearest Army hospital.

The scene opens with three men in wheel chairs playing cards on the sun deck of a hospital ship enroute home. One has lost an arm, one has lost a leg, and the third has lost both legs. In the background other wounded soldiers are amusing themselves, apparently light-heartedly, but the conversation of the three quickly reveals what must be in the minds of all: their doubts and fears of the future.

Reassurance is given by a Medical Corps Major who was an orthopedic surgeon — before he lost his arm. Over his voice the picture shows what happens to soldiers similarly wounded. How they learn to use their artificial arms and legs and finally are able to resume normal living. Further reassurance — as to how women react to disabled men — is given through the candid anecdotes of an Army nurse.

The War Department decided to release this film not only because of its informative value but to encourage a proper attitude on the part of the public towards disabled soldiers. The film is also of interest to medical men because of its portrayal of the Army Reconditioning Program.

Misbranded Products

Abstracts of Notices of Judgment issued by the Food and Drug Administration of Federal Security Agency.

[Editorial Note.—These Notices of Judgment are issued under the Food, Drug and Cosmetic Act, and in cases in which they refer to drugs and devices they are designated D. D. N. J. and foods, F. N. J. The abstracts that follow are given in the briefest possible form: (1) the name of the product; (2) the name of the manufacturer, shipper or consigner; (3) the date of shipment; (4) the composition; (5) the type of nostrum; (6) the reason for the charge of misbranding, and (7) the date of issuance of the Notice of Judgment—which is considerably later than the date of the seizure of the product and somewhat later than the conclusion of the case by the Food and Drug Administration.]

Stevens Concentrated Mineral Water — E. A. Stevens, Dawson Springs, Ky. Shipped March 2, 1942. Composition: essentially water, magnesium and calcium sulfates, and small amounts of sodium sulfate, sodium chloride, calcium carbonate and potassium chloride. Misbranded because, though product was a laxative, label failed to give adequate directions for use, and instead provided for continuous administration, whereas a laxative should not be used thus; also misbranded because labeling failed to warn that a laxative should not be taken when symptoms of appendicitis are present, or that frequent or continued use of such a product might result in dependence on a laxative. Further misbranded because label statements suggested that product would be efficacious in treating liver, kidney, stomach and blood disorders, dropsical trouble, rheumatism, malaria, and many other ailments. — [D. D. N. J., F. D. C. 814; December 1943], J. A. M. A. **127**:481 (Feb. 24) 1945.

Lieut. Kuehlthaw Rescued on Luzon

Lieut. Brunetta Kuehlthaw of West Bend, Wis., a physical therapist, was among those freed from Santo Tomas University, Manilla.

Disabled Soldiers Re-learn Driving

Disabled soldiers at Army amputation centers are learning to drive again under the tutelage of Army reconditioning instructors who have been specially trained for this purpose by the American Automobile Association. Dual control cars are used during part of the training period but the disabled soldiers, once they have learned how to compensate for their physical handicap, are taught to operate ordinary automobiles without any special "gadgets." The instructors prove it can be done. Most of them are themselves "disabled" soldiers!

Postwar Jobs in Physical Therapy

Students, teachers, parents, vocational counselors and others interested in postwar jobs will find helpful information on opportunities in Beekeeping and Physical Therapy in two new occupational abstracts just published by Occupational Index, Inc., New York University, New York 3, N. Y., at 25c each.

In concise, readable form each abstract covers the nature of the work, abilities and training required, methods of entrance and advancement, earnings, geographical distribution of workers, advantages and disadvantages, as well as postwar employment prospects. The best references for further reading are recommended.

Reconditioning Notes

One hundred students of the Army Occupational Therapy Emergency Course were placed in certain hospitals about Nov. 1, 1944 for a period of eight months' clinical training. These students had already had four months' training in civilian schools. Other courses are now being given and additional students will be assigned until the quota of 600 to be trained in this course has been filled. On satisfactory completion of apprentice's training, students will be eligible to registration as occupational therapists.

The School for Personnel Services is the new name for the School for Special and Morale Services at Lexington, Virginia, which offers two courses in reconditioning, the educational reconditioning course and the physical reconditioning course, the former for officers and enlisted men, the latter for officers only. Enlisted men qualifying in physical reconditioning are assigned to the A. S. F. T. C., Ft. Lewis, Washington, course for physical reconditioning instructors.

Snow Medal Awarded to Merritte W. Ireland

The presentation of the William Freeman Snow Medal for distinguished service to humanity to Major Gen. Merritte W. Ireland, formerly surgeon general of the U. S. Army, was a feature of the thirty-second annual meeting of the American Social Hygiene Association in Chicago recently. The thirty-second annual session of the American Social Hygiene Association was held in conjunction with the Chicago Conference on Social Hygiene and speakers included: Dr. C. Walter Clarke, New York, executive director, American Social Hygiene Association, Present and Future Public Health Problems in Social Hygiene; Dr. Herman N. Bundesen, president, Chicago Board of Health, Chicago Rapid Treatment Program.

Number of Occupational Therapy Technicians

The latest figures on registered occupational therapy technicians gives as registered in good standing, 1,222 and secondary registry in good standing, 20. A census of students currently enrolled in 17 accredited schools totals 1,692 civilians and 273 war emergency students.

Army Hospitals Seek Occupational Therapists

A serious shortage of occupational therapists, who play a vital role in the reconditioning of sick and wounded soldiers, exists in army hospitals, in addition to the lack of nurses and trained medical technicians. The Office of the Surgeon General reported that of the 1,800 qualified registered occupational therapists in the country the Army has only 225 and has immediate need for another 225. Openings exist in all parts of the country for this highly important work. Applicants who are employed on a civilian status must be graduates of a course in occupational therapy approved by the Council on Medical Education and Hospitals of the American Medical Association or must be a registered occupational therapist. The approved course has a minimum requirement of at least four years in an approved college. The Civil Service classification is subprofessional 5 and the pay is $1,800 a year, plus overtime. Applications for employment should be made directly to the Office of the Surgeon General, Washington, D. C., and application forms are obtainable at any post office.

Legislation

In the State of Indiana Bill S.193 has been introduced which proposes to enact a separate practice act relating to naturopathy and physical therapy and to create a board of natural therapeutic physicians to examine and license applicants in these fields.

Correction

Attention is directed to certain corrections in the article, "Wavelength Allocations for Diathermy" which appeared in the February issue of the ARCHIVES, page 88, paragraph three, last line 40 mc., should have read 50 mc.; page 91, caption "author's note" last paragraph, the first word should have read "these."

BOOK REVIEWS

HANDBOOK OF PHYSICAL MEDICINE. Selections Authorized for Publication by the Council on Physical Medicine, American Medical Association. First Edition. Cloth. Price, $2.00. Pp. 392. Chicago: American Medical Association, 1945.

There have been three editions of the Handbook of Physical Therapy. This book would have been the fourth edition were it not for the change of its name. It now becomes the first edition of the Handbook of Physical Medicine. Physical Medicine in the opinion of the Council is a term employed to define the diagnosis and the treatment of disease by various nonmedical means.

The aims of the Council on Physical Medicine are: (a) To protect the medical profession and thereby the public against inefficient and possibly dangerous apparatus and against misleading and deceptive advertising in connection with the manufacture and sale of devices for physical therapy; (b) to disseminate such reliable information as it possesses or may acquire and to stimulate instruction to aid the practicing physician in choosing true and sound physical therapeutic methods; (c) to act in an advisory capacity to the profession and to the public in all matters concerning this branch of medicine.

This handbook contains much reliable information on Physical Medicine and will aid every physician in choosing sound physical therapy. There are several new articles such as heat in surgical and orthopedic conditions by Dr. Frank G. Ober; body mechanics and posture by Dr. K. G. Hansson; therapeutic and remedial exercise by Dr. Frank H. Ewerhardt; occupational therapy in a private hospital by Dr. John S. Coulter; direct current applications and electrical stimulation of muscles by Dr. S. L. Osborne; physical characteristics of electrical energy by Howard A. Carter; physical therapy in infantile paralysis by Dr. Frank R. Ober and physical therapy in psychiatric practice by Dr. Winfred Overholser.

The Handbook of Physical Medicine is the outgrowth of twenty years of work by the Council on Physical Medicine of the American Medical Association. It represents a summary of the efforts of the Council during that period to separate the useful from the useless in this form of therapy, to evaluate the various physical therapeutic agents and the methods of their employment. It protects the medical profession from the snares and pitfalls, both ancient and new, found in this field. The authors of the articles show how a closer union between general medicine, surgery and physical medicine will result in a greater percentage of cure and relief of suffering humanity.

This handbook should be a textbook in every course in physical medicine for medical students and physical therapists. It should be read by every physician and surgeon.

OCCUPATIONAL THERAPY. War Department Technical Manual. T. M. 8-291. — Paper. Pp. 80 with 58 illustrations. Washington, D. C., U. S. Government Printing Office, 1944.

This is one of the three manuals on reconditioning. They are T. M. 8-290 Educational Reconditioning; T. M. 8-291, this manual and T. M. 8-292 Physical Reconditioning.

This manual discusses an overview of occupational therapy, functional occupational therapy, treatment of amputees; occupational therapy in neuropsychiatric disorders, diversional handicraft activities and industrial therapy.

FUNDAMENTALS OF INTERNAL MEDICINE. By *Wallace Mason Yater*, A.B., M.D., M.S., in (Med.), F.A.C.P., Professor of Medicine and Director of the Department of Medicine, Georgetown University School of Medicine; Physician-in-Chief, Georgetown University Hospital; Physician-in-Chief, Gallinger Municipal Hospital, Washington, D. C.; Formerly Fellow in Medicine, the Mayo Foundation; and twelve other contributors. Second Edition. Cloth. Pp. 1204, illustrated with photographs, tables and charts. Price, $10.000. New York and London: D. Appleton-Century Company, Incorporated, 1944.

This second edition of Yater's concise and readable textbook of internal medicine follows the same general plan as the first edition. The author has adhered strictly to essentials and has eliminated all unnecessary verbiage. Unproved theories and methods of treatment have been omitted. The result is a volume of moderate size which is extremely useful to the busy practitioner or student who desires to make a rapid survey of a current medical problem. Physiologic and pathologic features have been summarized as a background for the clinical aspects of the various diseases. The volume is adequately illustrated and there are numerous diagnostic charts.

Considerable new material has been added in this edition. Among the new subjects discussed are problems of war medicine such as aviation medicine, immersion foot, blast injuries, effects of chemical warfare, war neuroses and tropical medicine. Other new or revised subjects presented in this edition are primary atypical pneumonia, blood typing, hypoproteinemia, sarcoidosis, coccidioidomycosis, dicumarol and a preliminary evalution of penicillin. Three new sections have been added entitled, "Symptomatic and supportive treatment," "Clinical values and useful tables" and "The physician himself." The last of these

is especially valuable. The fifty page section on dietetics has been retained in this edition.

Some medical teachers object to Yater as the sole teaching text because of its brevity. The author himself suggests, however, that the present volume need not be the only text in medicine, but may be supplemented by the use of more voluminous works and the current medical journals. The reviewer is well impressed with this new edition and believes that it would be an unusually desirable addition to any physician's library.

TEXTBOOK OF THE EAR, NOSE, AND THROAT. By *Francis L. Lederer,* B.Sc., M.D., F.A.C.S., Professor and Head of Department of Laryngology, Rhinology and Otology, University of Illinois College of Medicine, Chicago; Chief of the Otolaryngological Service, Research and Educational Hospital, and *Abraham R. Hollender,* M.D., F.A.C.S., Assistant Professor of Laryngology, Rhinology and Otology, University of Illinois College of Medicine, Chicago. Price, $6.00. Cloth. Pp. 595. Illustrations 170. Philadelphia: F. A. Davis Company, 1942.

This textbook on the ear, nose and throat, is primarily didactic in nature, and intended for student and postgraduate use. It is, however, well adapted for the busy otolaryngologist who wishes a quick reference for the latest in ear, nose and throat procedures. The paper is of good quality, the printing is excellent and the illustrations are clear, well chosen and informative. The text contains ten sections, with special attention to improved diagnostic methods, principles of treatment and the indications for surgical and nonsurgical procedures. The section on diseases of the nasal accessory sinuses is especially well prepared and presents the subject in a logical and conservative manner. One of the outstanding features of the book is the careful differential diagnosis given in connection with each disease. The use of the sulfa drugs has been clearly evaluated in those conditions in which they are suitable. This book fills a long felt want for an up to date text for students. It is unique in the fact that it is both concise and comprehensive.

INTERNAL MEDICINE—ITS THEORY AND PRACTICE. In Contributions by American Authors. Edited by *John H. Musser,* B.S., M.D., F.A.C.P.; Professor of Medicine in The Tulane University of Louisiana School of Medicine; Senior Visiting Physician to the Charity Hospital, New Orleans, Louisiana. Fourth edition, thoroughly revised. Pp. 1518, illustrated. Cloth. Price, $10.00. Philadelphia: Lea and Febiger, 1945.

This book is made up of twenty-six chapters with contributions made by thirty-three American authors. This standard work was written with two distinct objectives in mind. It was designed to give to the undergraduate student a textbook written by a limited number of well qualified authors who would be able to present the essentials without allowing the work to become encyclopedic in size and impractical for study or handling. Its second purpose was to give to the practitioner of medicine a work of ready reference so documented that he could go at once to the sources of material or to the outstanding contributions of medical literature for more detailed information. With the advance in medicine, numerous changes and additions had to be made to include some of the newer therapies, such as sulfonamides, penicillin, thiouracil and many others. A certain amount of space also has been devoted to the problems of war medicine, notably in conjunction with the protozoan and metazoan diseases and the acute infectious diseases. Military neuropsychiatric disabilities, war neurology and altitude sickness all receive attention.

The contents are divided into four parts. 1, Infectious disease; 2, systemic disease; 3, diseases of nutrition, allergy metabolism, physical and chemical agents, and 4, diseases of the nervous system.

The reviewer believes that this book is well written and meets the objectives mentioned before and recommends it as a ready reference book for internal medicine. For a large volume, the book is well-bound and easy to handle.

ANATOMY AS A BASIS FOR MEDICAL AND DENTAL PRACTICE. By *Donald Mainland,* M.B., Ch. B., D. Sc., F.R.S.E., F.R.S.C., Professor of Anatomy, Dalhousie University, Halifax, N. S., Canada. Medical Student Series. Price, $7.50. Pp. 863, with 61 illustrations. New York, Paul B. Hoeber, Inc., (Medical Book Department of Harper & Brothers), 1945.

This is not just another textbook of anatomy but an experiment in a new method of teaching the subject. It is written primarily for medical and dental students, but the graduate physician and surgeon will find it a useful reference as well. In the first part the student is advised how to approach the subject and how and what to study. The body as a whole is considered under the section on general anatomy with individual chapters on bones, joints, muscles, blood vessels, nerves and skin. Regional anatomy is described in the third part including the brain, spinal cord and autonomic nervous system.

A distinctive feature of the presentation is the inclusion of the functional aspect of the various tissues and even something of their physiology. The anatomic arrangements which the doctor will later find to have particular clinical significance are emphasized, whereas less important details are purposely omitted. The student is thus guided throughout in the essentials to be learned and remembered and it is hoped by this method that total material retained will be greater than when studied in the traditional manner. Those particularly interested in disorders of locomotion will find the chapters on nerves, muscles and joints outstanding because of the emphasis on function. The questions and answers at the end of each chapter are a valuable feature as well as the abundant references. There are relatively few illustrations, so that the student might desire to use a pictorial atlas in addition. This book is highly recommended as a text for students which should make anatomy a subject more interesting to learn and less easy to forget.

PHYSICAL MEDICINE ABSTRACTS

Frontiers of Multiple Sclerosis. II. Treatment of Multiple Sclerosis, with Special Reference to Fever Therapy, Prolonged Rest and Climatotherapy. Walter Freeman.

M. Ann. District of Columbia **13**:67 (Feb.) 1944.

Multiple sclerosis is as variable in its clinical pattern as it is in its pathology. Aside from the cadre of symptoms and signs, its outbreaks are mystifying and its remissions inexplicable. Fulminating cases may lead to death in a few weeks or even days. Equally violent attacks may lead to the point of death and then clear up, usually with residuals. Sometimes the disease may coast along for years and then blow up in a final explosion that may cause death in a matter of days. At other times the disease may continue on for decades with little indication of progression. Symptoms and signs come and go and their places are taken by others. Sometimes the remissions are so complete and last for such a long time that reasonable doubt can be expressed whether the disease ever existed.

For many years the use of fever therapy has been advocated in multiple sclerosis. Early cases clear up as if by magic under its influence at times, yet the only early case under the observation of the author treated by this method died within a month. Bennett and Lewis claim that the early cases are benefited, but the late cases are made worse. The experience of the author with fever therapy, either by typhoid vaccine intravaneously or malaria, has been wholly bad, all 11 cases being unchanged or worse after the treatment. Since clinical observation indicates that many of the patients who are followed over a long period of time suffer relapses during acute infections of various sorts, the use of fever therapy in multiple sclerosis is mentioned only to be condemned.

The general conclusions arrived at from a long term study of patients with multiple sclerosis are that prolonged rest is the one most important factor in the early treatment of the condition and that a warm climate with freedom from upper respiratory infections is the best insurance against further crippling recrudescences of the disease. Lacking definite knowledge of the specific etiologic agent of multiple sclerosis and any specific remedy, the patient is obliged to depend on his own immunity mechanisms to hold the disease in check. This immunity is apparently a rather uncertain one, one that must be built up at the expense of giving up competitive activity in metropolitan centers, but nevertheless an immunity that may last over long periods of time, measured even in decades.

The same principles hold true in the treatment of certain other chronic and relapsing conditions that may eventually prove crippling, such as tuberculosis, arthritis, rheumatic heart disease, colitis, peptic ulcer and the like. And in some of these disorders a great deal more is known of etiologic factors than is the case in multiple sclerosis. Especially as regards tuberculosis, the importance of rest and climate are so well established that even the various surgical and other therapies have not taken the place of rest and climate. Furthermore, the results in cases satisfactorily handled during the early stages of tuberculosis are so much more satisfactory than those in which the disease is far advanced that it should be obvious that we can learn a good deal more in the treatment of multiple sclerosis from applying the same principles.

Physical Fitness Must be Started Before Birth.

Editorial: J. Maine M. A. **35**:233 (Dec.) 1944.

Dr. Charles H. Keene, editor of the Journal of School Health, feels that intensive instruction and habituation in the field of healthy living, in safety measures and in the control of infection would be of far greater value to students generally than any other type of education in the field of health and physical fitness. He further states: An analysis of the situation as it relates to the physical fitness of American youth indicates that the problem demands a multiple approach. Improvement of physical fitness must begin even before birth with proper prenatal care, extend through infancy with an immunization program that might prevent infectious diseases of childhood and their crippling complications, and go on through the nursery and kindergarten, where sound habits of nutrition begin to be established, carry through grade school, high school and college, in which sound instruction in health habits and physical activities, including competitive sports, should be integrated in the curriculum. Finally, when the boy or girl has left school there must be continuing participation in healthful living, sports and recreational pastimes to maintain the physical fitness that the schools have established. The development of such a program demands a nationwide participation and depends for its success on the cooperative efforts of physicians and all the accessory medical professions, physical educators, health educators, industries and the general public.

Physical Fitness.

J. A. M. A. **126**:991 (Dec. 9) 1944.

To the Editor:—I am interested in determining in as quantitative manner as possible a patient's fatigability. This is an individual who alleges disability because of extreme and undue fatigue. I am unable to find any objective testing methods in the literature more recent than the Schneider

test of the first world war. Can you describe any newer testing procedures of value?—M.D., Ohio.

Answer.—Valid and reliable measurement of the ability of a person to resist fatigue is more complex than is usually appreciated. The problems involved have received detailed attention and wide consideration since the beginning of the war. A basic introduction to the limitations and possibilities of such testing may be obtained from Burns, David: The Assessment of Physical Fitness, Nature, London **144**:466 (Sept. 9) 1939; Simonson, Ernst, and Enzer, Norbert: Physiology of Muscular Exercise and Fatigue in Disease, Medicine **21**:345 (Dec.) 1942, and Taylor, H. L., and Brozek, J.: Symposium on Physiological Aspects of Convalescence and Rehabilitation-Evaluation of Fitness, Fedeation Proc. **3**:216, 1944.

The simplest tests of fitness are cardiovascular and respiratory. Many have been described in the physiologic literature of the last two decades. In addition to the Schneider test, the best and most commonly used include the tests described by Crampton, C. W.: Am. J. M. Sc. **160**:721 (Nov.) 1920; Flack, M.: Lancet **2**:593 (Sept. 17) 1921; Turner, A. H.: Am. J. Physiol. **87**:667 (Jan.) 1929, and Master, A. M.: Am. Heart J. **10**:495 (April) 1935. Numerous motor performance tests may be found in the physical education literature. Representative examples appear in Brace's Measuring Motor Ability, New York, A. S. Barnes & Co., 1930. Recent additions should include Cureton's motor fitness screen test (The Journal, Sept. 11, 1943, page 69), and the numerous studies of Brouha and his associates (New England J. Med. **228**:473 (April 15) 1943; Am. J. Phys. Anthropol. **1**:95 (March) 1943; Rev. canad. de biol. **2**:86 (Feb.) 407, 1943; Yale J. Biol. & Med. **15**:657, 671, 679, 689 (May); 769, 781 (July) 1943). The third type of test evaluates the ability to resist fatigue in terms of the response to sensory stimuli. The most recent development in this field is the fusion frequency of flicker measurement described by Simonson and Enzer (J. Indust. Hyg. & Toxicol. **23**:83 (Feb.) 1941).

There is no simple answer to this query. More would have to be known about the case history before specific testing procedures could be recommended as probably capable of reliably differentiating the abnormal person from the normal.

Electric Convulsive Therapy of the Psychoneuroses. Lothar B. Kalinowsky; S. Eugene Barrera, and William A. Horwitz.

Arch. Neurol. & Psychiat. **52**:501 (Dec.) 1944.

The simplicity of electric convulsive therapy and its possible application to ambulatory patients seem to favor its indiscriminate use in treatment of all types of psychoneuroses. This possibility suggested a broader clinical investigation for the purpose of determining the actual value of this method for the neuroses. Another reason for such a therapeutic study was the expectation that a comparison of reactions in the neuroses and those in the major psychoses might contribute to a better understanding of the effect of shock treatment in general. The difference between the effect of electric convulsive therapy and that of other organic methods applied in treatment of the neuroses promised to offer further points of interest.

The question of the advisability of electric convulsive therapy of a psychoneurosis is far more difficult than the advisability of such treatment for the major psychoses. For the affective disorders and for schizophrenia the shock therapies are the only methods in general use, and the results are gratifying in a considerable number of patients. For treatment of the neuroses psychologic methods are available, and electric convulsive therapy would be indicated only if the results were superior. Statistical reports on the results of psychotherapy with the neuroses, regardless of the form used, seem to vary within narrow limits, as has been observed only recently with war neuroses. In most statistics on peacetime neuroses the percentage of patients showing improvement ranges between 60 and 70 per cent when persons showing great improvement and those showing slight improvement are considered together. Our figures for electric convulsion therapy reach these values only for a few types of neurotic patients.

Hereditary Periodic Paralysis in a Family Showing Varied Manifestations. C. P. Oliver; Mildred R. Ziegler, and Irvine McQuarrie.

Am. J. Dis. Child. **68**:311 (Nov.) 1944.

Periodic family paralysis is a relatively rare disease of human beings. In an extensive review of the literature on the subject, Talbott stated that approximately 400 typical cases have been reported since Musgrave first described a case in 1727.

The disease is characterized by the periodic development of acute flaccid paralysis, which usually begins in the extremities and progresses toward the trunk. The patient loses the power to move his limbs, but he can usually breathe, eat and speak freely, and the functions of his internal organs appear not to be disturbed. The deep reflexes of the affected extremities are absent at the height of the attack. After a period of time, usually a few hours, but in some instances two or three days, the patient recovers from the attack spontaneously.

In their summary the authors report that sixteen members of a family are subject to attacks of periodic paralysis. The trait behaves in this family as a mendelian dominant with full penetrance but with varied manifestations. The manifestations, as shown by the age of onset, the frequency, duration and severity of the attacks and the duration of the disease, are as varied as those observed when nonrelated affected persons are compared. The variability of the manifestations may be due in part to intrinsic factors.

Estimation of Best Radiation in Clinical Practice. David S. Evans, and K. Mendelssohn.

Brit. M. J. **4381**:814 (Dec. 23) 1944.

The administration of infra-red radiation for clinical purposes still relies to a great extent on guesswork. The problem of exercising quantita-

tive control over the administration of infra-red radiation is far more complex than in the case of roentgen rays. Heat radiation is considered harmless, since overdosage is registered almost instantaneously by pain, whereas overdosage of x or radium rays is insidious, their effects not becoming apparent until some time after administration. It must be remembered, however, that weak sources of infra-red radiation are probably of little clinical value and that powerful radiators producing definite clinical effects are by no means harmless.

The thermo-radiometer is essentially a laboratory instrument, but it holds out good prospect for development into a simple radiation-flux indicator for clinical use. When this problem of accurate estimation of total flux has been solved the next step must be to devise an instrument capable of differentiating flux received by the patient in different wavelengths, an instrument capable of assessing the quality of radiation.

Meanwhile, a great deal can be done by an accurate determination of the total radiation flux received under various conditions from standard treatment lamps and thus to ensure more reproducible and better-defined conditions of treatment of infra-red rays. While roentgen rays are more or less uniformly absorbed by the tissues, in which they produce chemical changes, the action of infra-red rays result mainly in an increase in temperature produced near the surface of the skin, which is counteracted by perspiration and by dissipation of the local increase in temperature by the circulation. While a certain amount of information as to the penetration of infra-red radiation exists, little is known about the specific action of heat radiation under clinical conditions. The physiologic action of a given type of heat radiation is likely to be quite different in local and in general administration. The greatest need is for clinical observations of the effects of infra-red radiation administered in known quantities and under well defined conditions.

Nerve Traumatization in Treatment of Poliomyelitis.

To the Editor:—A recent article in Time referred to the treatment of poliomyelitis by crushing the nerve above the point of muscular wasting. This form of treatment has been suggested by Lieut. Comdr. Harvey Ellsworth Billig, Jr. (MC) and a physiologist, Anthonie Van Harrevelt of the California Institute of Technology. According to the report, this procedure of nerve crushing can now be done bloodlessly with an air driven rivet gun, and the Time article said that it has been performed on 500 patients in Los Angeles and 40 in Philadelphia with remarkably good results. A friend of mine who has a paralyzed son has asked me to find out the value of this treatment. The boy in question has been paralyzed in the right leg for a number of years.—Thomas M. Adams, M.D., Montezuma, Ga.

Answer:—The benefits to be derived from the operation described by Lieutenant Commander Billig, consisting in crushing a nerve above the point of muscular wasting in patients who have suffered from infantile paralysis, are not yet sufficiently proved for the procedure to be accepted by men who have had the greatest experience with the problem of paralysis following anterior poliomyelitis. The recently suggested procedure of traumatizing the nerve with an air driven rivet gun will require much more controlled study before it can be recommended. Trauma of any kind will produce varying degrees of hyperemia. Hyperemia is a reaction of repair. Such a reaction may be of some benefit in stimulating recovery of tissues which have been injured. No procedure carried out on peripheral nerves or other peripheral tissues can be of any value in regenerating or restoring destroyed anterior horn cells. The major pathologic change in paralysis from poliomyelitis consists in the damage to these anterior horn cells. For that reason, in most cases at least, the approach to the problem is from the wrong direction when treatment is given to peripheral nerves. This treatment would be of doubtful value to the boy with paralysis in the right leg which had been present for a number of years.—J. A. M. A. **127**:368 (Feb. 10) 1945.

The Physical Therapy Prescription. Jessie Wright.
Physiotherap. Rev. **25**:22 (Jan., Feb.) 1945.

Physical therapy should be prescribed with the same thought and precision as when selecting and dosing drugs. Much misconception and confusion have arisen in the past because physical treatment has not been prescribed according to age, individual tolerance and general or local pathologic changes. Too often physical therapy is prescribed when it is contraindicated or not specifically needed, resulting in the treatment falling into disrepute. In other instances spectacular cures are attributed to treatment by physical measures when perhaps the progress had reached a place when improvement could be expected anyway; in this manner physicians and patients are led to expect too much from such therapy. If used when indicated and transitions in treatment keep pace with the changes in pathology, then a scientific rational system may be followed and reasonable results anticipated.

The efficiency of a department of physical therapy may be seriously impaired by having the available time and space for treatment monopolized by old cases which have passed a point where specific benefit may be expected but whose orders have not been changed by the attending physician. This state of affairs is an unnecessary expense to the institution or patient, or both, and discouraging to a physical therapist who could treat other and more critical cases more efficiently and effectively. It is as important to know just when to terminate or make a transition in physical therapy as it is to know just when to prescribe it. The cooperation between the physical therapist and the physician-director of the department should be on a basis of understanding which permits the former to call attention of the latter to cases which seem to be at a standstill or where change might be advantageous. If necessary, the physician-director should take up questions related to changes in treatment with the attending

physician. Everyone concerned is benefited by such teamwork.

Ultraviolet Radiation in Surgery. Boy Fraser.

Canad. M. A. J. 51:409 (Nov.) 1944.

Ultraviolet radiation in surgery has not received the full clinical and experimental study which it deserves if its value is to be appraised correctly. There should be cooperation between surgeons and laboratory investigators. Experimental studies should be organized with operating room conditions and procedures in mind, and surgeons should accept or reject the use of ultraviolet radiation on a scientific basis rather than on personal preferences or dislikes for the technics involved.

The present status of ultraviolet radiation in surgery, both clinically and experimentally, has been outlined. Experimental evidence of the effects of such radiation on seeded plates and on visceral tissues has been presented. Emphasis is laid on the need for a full program of preventive measures, particularly with regard to ward infections, rather than too great dependence on any one of such measures. In view of increased understanding of air-borne infection it is felt that we may be neglecting to utilize a valuable method of safeguarding operative wounds from microorganisms in the air of the operating room. Aside from outright infection, the prevention of wound contamination is important. The results already obtained both in clinical and laboratory investigations make further studies desirable.

Hazards of Hypertherm Treatment.

J. A. M. A. 127:125 (Jan. 13) 1945.

Wallace and Bushby investigated changes occurring in patients undergoing hypertherm treatment to ascertain whether chemotherapy increases the risks and to discover prophylactic or therapeutic means of eliminating or minimizing the danger inherent in the treatment. They report clinical observations on 254 cases undergoing hypertherm treatment at 106.6 F. for eight hours. Of these, 37 were the subject of a detailed clinical, hematologic and biochemical investigation. The most constant and prominent features were the development of anoxia and of bilirubinemia progressing to definite clinical jaundice in 37 cases. Hippuric acid tests for liver function showed a considerable reduction in this function. Patients with jaundice should be treated as if they had hepatitis and should be kept warm in bed for at least three days or until the jaundice clears. Continuous oxygen and carbon dioxide therapy lessens, though it does not abolish, the anoxia. It appears to prevent circulatory collapse. Vomiting was less frequent after its introduction. Circulatory collapse is a failure of the vasomotor and respiratory centers and is not due to a reduction in the volume of the circulating blood or to myocardial failure. The use of morphine is contraindicated. Hypertherm treatment causes a transient polymorphonuclear leukocytosis and a transient hemodilution. There is a small transient rise in nonprotein nitrogen and a tendency for plasma chlorides and urinary chlorides to fall. The treatment has considerable dangers. The duration must be decided by the medical officer observing each case, but the following are suggested as indications for terminating treatment immediately: (1) fall of systolic blood pressure below 100 mm. of mercury, (2) disorientation, (3) pulse rate persistently over 160 per minute, (4) respiratory rate persistently over 50 per minute, (5) temperature of 107 F. for a quarter of an hour, (6) restlessness and violence, (7) coma, (8) pallor superimposed on cynanosis, (9) intolerance on the part of the patient, the restlessness of an intolerant patient adding greatly to the risks inherent in the treatment, (10) persistent vomiting. Catarrhal infection and nasal obstruction should be regarded as contraindications to treatment. The patient should be examined preparatory to the hypertherm treatment so as to exclude those with cardiovascular, respiratory, renal or hepatic disease. The treatment should be carefully explained beforehand to prepare the patient for his physical and mental ordeal. Oxygen and carbon dioxide should be given for at least an hour after treatment or until color improves. Premedication with 6 Gm. of sulfathiazole does not increase the hazards of hypertherm treatment.

Refrigeration Anesthesia for Amputations. Sergei S. Yudin.

Am. Rev. Soviet Med. 2:12 (Oct.) 1944.

Ninety-two of the 106 amputation stumps healed by primary union after tight closure without drainage or with a temporary rubber drain and dusting with sulfanilamide. Four cases, one of the forearm, one of the knee, and two of the thigh, developed an infection which necessitated removal of the sutures and reopening of the wound.

First, refrigeration anesthesia is superior to all other anesthetics in that it does not introduce an additional toxic agent into the body. Second, the anesthesia is absolutely complete in that it eliminates the conduction of all painful, tactile, and other stimuli along the spinal and sympathetic nerve paths. This is of particular importance, since incomplete anesthesia is a major cause of operative shock.

Refrigeration anesthesia, on the other hand, gradually reduces nerve conductivity and probably causes it to disappear at a relatively high temperature of the surrounding tissue. Third, it appears that the progressive warming of the stump after the operation not only gradually restores conductivity in the severed nerves but also provides a safety valve against excessive stimulation of the receptor centers in the brain, which inevitably occurs when the paralyzing influences of local or general anesthesia are suddenly removed.

The fourth useful factor in the prevention of shock is the retarded absorption of toxins from the stump. The theory that absorption of toxic products contributes to the production of shock may not be as popular as it was at the end of the first World War, but it should not be entirely discarded.